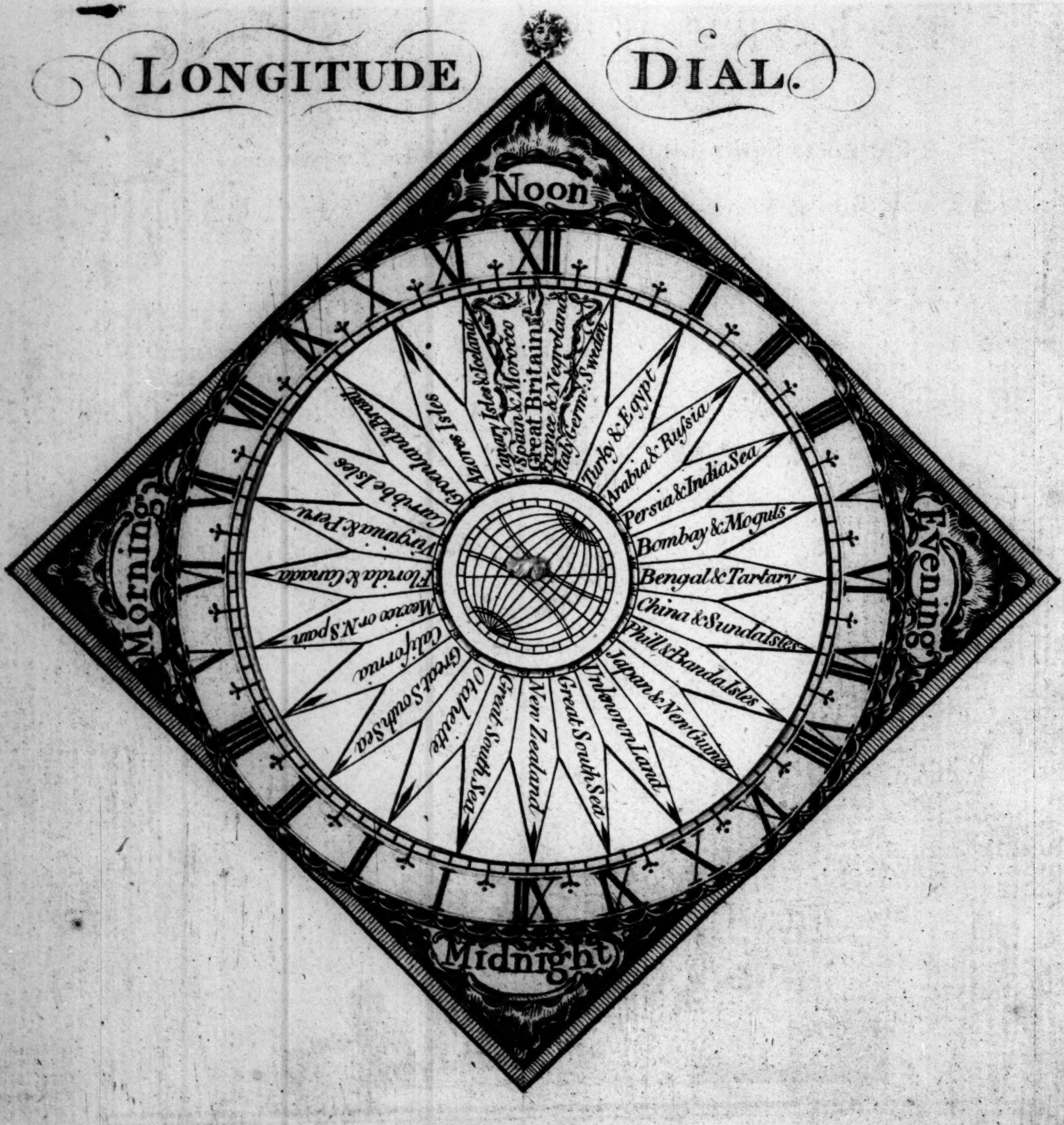
LONGITUDE DIAL.



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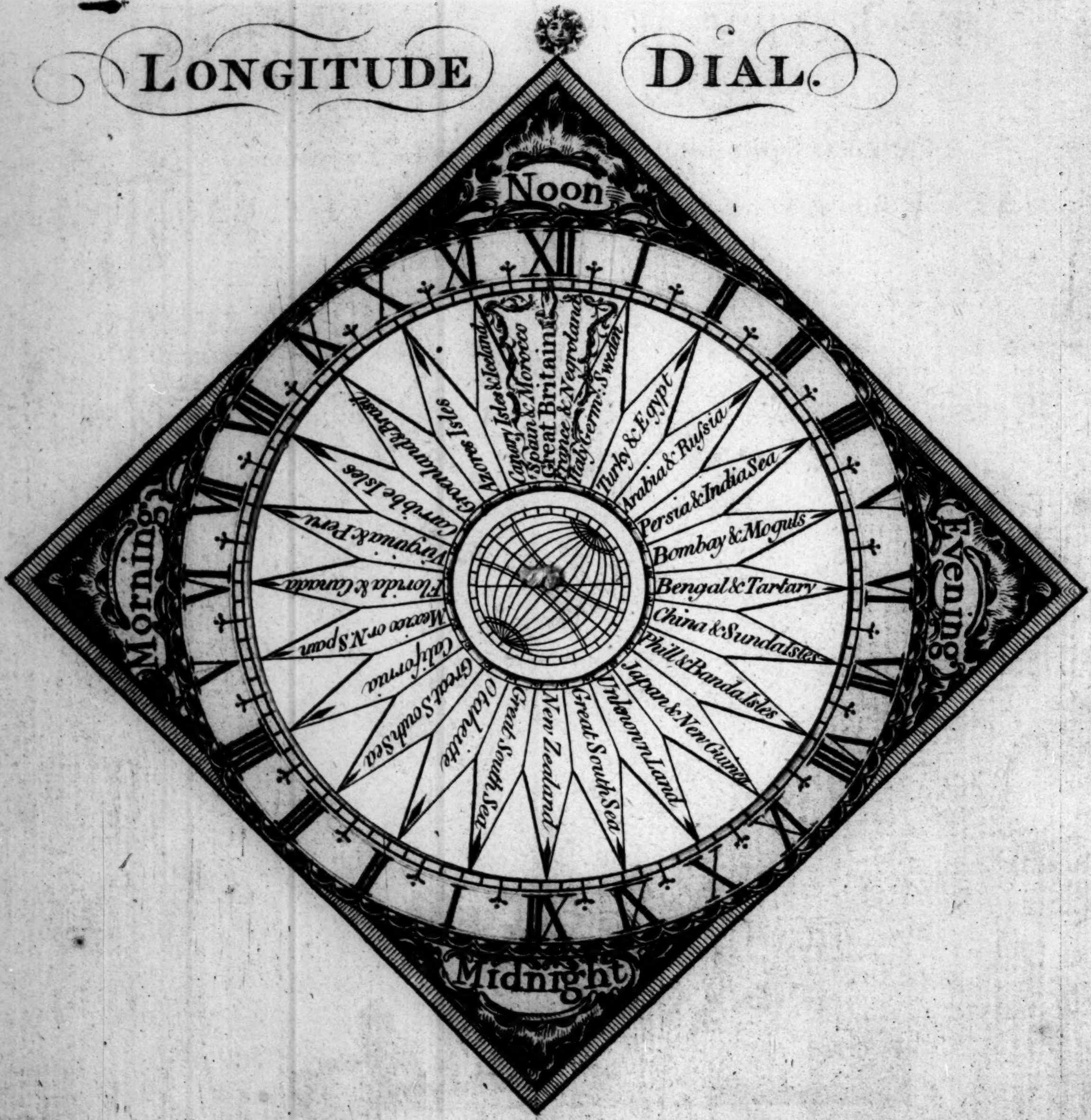
LONGITUDE DIAL.



See Explanation page 45.

Thomas Blackmore.

SCIENCE IMPROVED

OR THE

THEORY OF THE UNIVERSE.

COMPREHENDING

A RATIONAL SYSTEM of the moſt Uſeful as well as Entertaining Parts of

NATURAL AND EXPERIMENTAL PHILOSOPHY,

EMBELLISHED WITH

COPPER-PLATES, on a NEW-INVENTED MOVEABLE CONSTRUCTION.

Calculated to explain the occult Properties of Nature, with the various Phænomena of the Heavenly Bodies, upon the true Principles of REASON and RELIGION.

ONE SUN BY DAY, BY NIGHT TEN THOUSAND SHINE,
AND LIGHT US DEEP INTO THE DEITY.

Intended for the Inſtruction and Amuſement of the BRITISH YOUTH of both Sexes.

Animus, prudens Scientia.

BY THOMAS HARRINGTON.

LONDON:
Printed for the AUTHOR; and Sold by S. CROWDER, Pater-Noſter-Row; J. WALTER,
Charing-Croſs; and W. SHROPSHIRE, New Bond-Street.
MDCCLXXIV.

TO HIS

ROYAL HIGHNESS

GEORGE,

PRINCE OF WALES.

SIR,

THE following Treatiſe lays Claim to your Royal Protection, for it is written on a Subject which Princes ſhould have moſt at Heart—THE IMPROVEMENT OF SCIENCE.

Each Branch of human Literature hath had its Admirers; but Men of Wiſdom in every Age have been unanimous in aſſigning a Preference to Aſtronomy. This, Sir, whether we conſider it as having a Tendency to enlarge our Views of Nature, refine our thinking Faculties, or excite in our Minds ſublime Conceptions of the CREATOR: Whether we view Aſtronomy merely as a pleaſing Speculation, or reflect on its immenſe Utility to Mankind, it certainly merits the higheſt Encomiums in the Power of Mortals to beſtow.

Naturaliſts affirm, that each Spire of Graſs proclaims THE EXISTENCE OF GOD: The Objects about which Aſtronomy is converſant, do more than barely proclaim his Exiſtence; the radiant Beams of thoſe Celeſtial Luminaries AFFORD LIGHT, WHILE WE TRACE THE FOOTSTEPS OF THE DEITY IMPRINTED ON ALL THE HOST OF HEAVEN.

A Science, thus ſerving as an Handmaid to Theology, has a peculiar Claim to the Patronage of Princes. May you, Sir, afford that Patronage! And in Return, may each Star propitious ſhed its benign Influence on your Royal Head, and win your Heart to Virtue! As the Sun matures our tender Infan tFrames to Manhood, may the IMMATERIAL SUN ripen your Infant Mind, ſublime your Thoughts, and, by his influential Power, prompt you ſo to act as that your Virtues may reflect Dignity on your Rank, Luſtre on your Titles, and Happineſs on your Country.

This is the Wiſh of

Your HIGHNESS's

moſt obedient,

moſt devoted,

humble Servant,

T. HARRINGTON.

TO THE

READER.

THE deſign of the following Treatiſe is to make the Youth of both Sexes acquainted with the principal Part of Natural Philoſophy.

The generality of Books hitherto written on theſe Subjects, are too Scientific to be pleaſing, too Abſtruſe to be underſtood without more Application than the volatile nature of Youth will permit. The Author hath therefore eſſayed, to convey the Principles of Philoſophy, and to explore the Phœnomena of the Effects in a Style adapted to every Capacity.

Practical Theorems were found neceſſary to elucidate and exemplify the Principles laid down; but ſuch Theorems only were choſen, as by their eaſy Solution might invite the Pupil to proceed to the Attainment of higher Diſcoveries.

On the whole, if in a diſſipated, thoughtleſs, and unmanly Age, this Book ſhall be found worthy the Approbation of one Votary to Virtue, or ſhall incite one Votary to Vice, to a purſuit of ſublimer and more exalted Objects, the Author's end will be accompliſhed. That Man, though not indifferent to, muſt yet be unmoved by popular Cenſure or Applauſe, who acts ſo as to merit the Approbation of his own Heart.

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INTRODUCTION.

INTRODUCTION.

THE Creation, as Mr. *Addiſon* finely obſerves, is a perpetual feaſt to the mind of a good man. Every thing he ſees chears and delights him; Providence has imprinted ſo many ſmiles on the face of Nature, that it is impoſſible for a mind not ſunk in meer groſs and ſenſual delights, to take a ſurvey of them without ſeveral ſecret and grateful ſenſations of pleaſure.

Natural Philoſophy is that liberal Science which is

Slave to no Sect, ſhe takes no private road
But looks thro' Nature, up to Nature's God.

It makes us ſenſible of the pleaſure that gives us a taſte of the Creation, and renders it not only pleaſing to the imagination, but to the underſtanding. It does not permit the mind to reſt ſatisfied merely with the murmur of Brooks, and the melody of Birds in the ſhades of groves or woods, or in the embroidery of fields or meadows; but nobly conſiders the ſeveral wiſe ends of Providence which are ſerved by them; it heightens the pleaſure of the eye, inſpires virtue, and raiſes ſuch a rational admiration in the ſoul, as is little inferior to true devotion; for that chearfulneſs of heart which ſprings up in us from a ſurvey of Nature's works is an admirable preparative for gratitude. The mind has gone a great way towards praiſe and thankſgiving, that is filled with ſuch a ſecret gladneſs, productive of a generous and grateful reflection on the *Supreme cauſe* which produces it; ſtamps it in the ſoul, and gives it its proper value. Such an habitual diſpoſition of mind conſecrates every field and wood, turns an ordinary walk into a morning or evening ſacrifice, and will improve thoſe tranſient gleams of joy which naturally brighten up and refreſh the mind on ſuch occaſions, into an inviolable and perpetual ſtate of bliſs and happineſs.

How great, how benevolent then is that ſupreme power and wiſdom that *hung the* * *Earth upon nothing?* that beautifully diſtinguiſhed it into Mountains and Rivers, Hills and Vales, to embelliſh the ſcene and deverſify the proſpect? Who covered the dry land with ſuch a lovely verdure, a carpet of green foliage, a colour the moſt agreeable and uſeful to the eye? Who decked and ornamented this terraqueous nurſery of man with plants and flowers ſo exquiſitely adorned with various inimitable beauties, *that even Soloman in all his glory was not arrayed like one of them.*

A ſurvey of this beautiful ſcene of things is enough to convince us of the being and providence of God, and tells us, it was the Omnipotent, the great *Immanuel* that placed the † plant in the ſeed in ſuch curious and elegant foldings, as afford at once both a pleaſing and aſtoniſhing ſpectacle: That painted and perfumed the flowers, gave them the ſweet odours which they diffuſe in the air for our refreſhment and innocent delight, and dyed them into different colours, ſurpaſſing the imitation, as well as the comprehenſion of mankind. It was the Deity who *weighed the Mountains in ſcales and the Hills in a ballance*, and diſpoſed of them in the moſt proper manner for fruitfulneſs and health, as well as the entertainment of the Traveller. Every thing in this bliſsful Paradiſe around us is ſo wiſely contrived, that nothing can be altered for the better; this drew from the *Pſalmiſt* theſe raptures of admiration and expreſſions of gratitude, *How manifold are thy works, O Lord; in wiſdom haſt thou made them all! The earth is full of thy riches. They that go down to the Sea in ſhips, theſe ſee the Works of the Lord, and his wonders in the deep.* Pſalm cvii.

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* *Milton* thus finely deſcribes the *obliquity* of the Earth.

—Some ſay he bid his Angels turn
Aſkance the poles of Earth twice ten Degrees or more
From the Sun's axis: They with labour puſh'd,
Oblique the central Globe.

† The Microſcope has diſcovered to us that every ſeed hath in itſelf, what the Phyſiologiſt calls the *Planta Seminalis*, or *Seed Plant*; that is, that the plant which is produced from the ſeed

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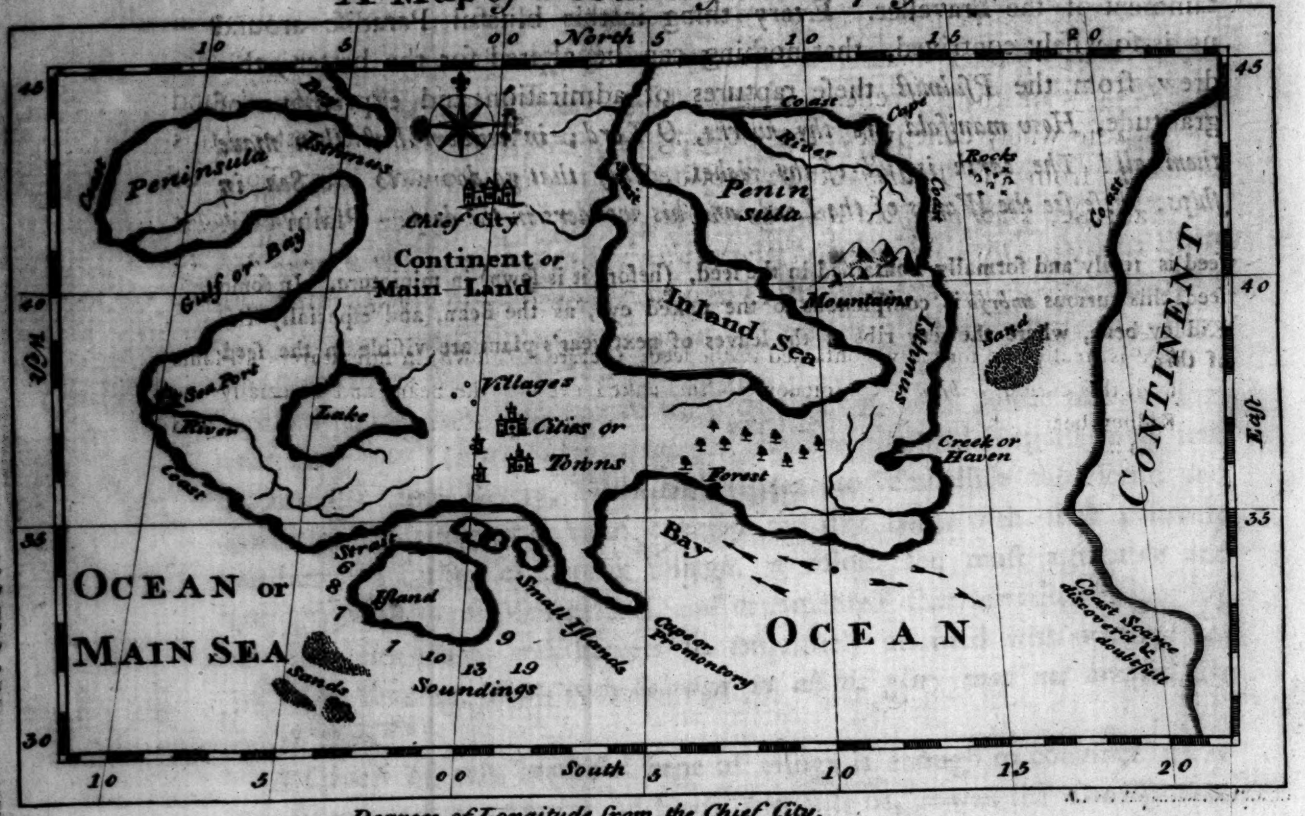
ſeed is really and formally contained in the ſeed, (before it is ſown) in miniature. In ſome ſeeds this curious *embryo* is conſpicuous to the naked eye, as the Bean, and eſpecially the Kidney-bean, where the very ribs of the leaves of next year's plant are viſible in the ſeed of this.

A Map *of a* Country *exemplified.*



Degrees of Longitude from the Chief City.

SECTION I.

SCIENCE IMPROVED.

GEOGRAPHY is the doctrine or knowledge of the terreſtrial Globe, or the Science that teaches and explains the properties of the Earth, and the parts thereof, which depend upon quantity, *viz.* Its figure, place, magnitude and motion, with the celeſtial appearances. We ſee the Heavens over our heads, and tread on the Earth with our feet; but are at a loſs what to think of that mighty concave above. The changes that happen and every glorious object ſeen there perplex the untutored mind with vague conjectures which give it a propenſity to inquire, what means thoſe multitude of glittering Stars ſcattered over the extenſive canopy of the whole Heavens; who placed them there, and for what purpoſe? When we ſee a clock or any curious piece of Mechaniſm, we immediately conclude it the work of ſome great Artiſt. How great that Artiſt then who formed the vaſt variety, order and beauty which ſo conſpicuouſly appears throughout the liberal Creation? All Nature tells us it is the work of God; and Reaſon tells us the whole of this vaſt ſyſtem is contrived, framed and faſhioned by that benevolent, wiſe and all powerful Deity.

The Earth, which is the Planet we live upon, is a great [*] Globe which has often been circumnavigated or ſailed round; and the ſurface of this earthly Globe is divided into Sea and Land. The Promontories and Capes ſhoot into the Sea; the Bays and Creeks on the other hand run as far into the Land. The Land is about one third the ſurface of our whole

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[*] The general opinion of the Antients was, that the Earth was a large extended plain ſurface like a round table, and all below was *Hades* or Hell, and that the Sun and the reſt of the heavenly Bodies deſcended into the *Weſtern Ocean* every night, and roſe out of the Eaſtern every morning; and not many ages ago, the notion of *Antipodes* was zealouſly oppoſed: but all theſe abſurdities are now given up, being obliged to yeild to *Obſervation* and *Experience*, for our Mariners frequently ſail round the Globe, and tranſact buſineſs with the *Antipodes* of many nations daily.

Globe, and is generally divided into the following parts, an *Iſland*, a *Continent*, a *Peninſula*, an *Iſthmus*, a *Promontory*, or a *Coaſt*.

An *Iſland* is a country or portion of land compaſſed about with Sea or other water, as *Great Britain*, *Ireland* in the Britiſh Seas; *Sicily*, *Crete*, *Cyprus*, &c. in the Mediterranean Sea; the Iſles of *Wight*; of *Angleſey*; of *Man*; as alſo *Madagaſcar* and *Japan*, &c.

A *Continent*, properly ſo called, is a large quantity of Land in which many great countries are joined together, and not ſeparated from each other by the Sea, ſuch are *Europe*, *Aſia*, *Africa*. This is ſometimes called the *Main Land*.

A *Peninſula* is a part of Land almoſt incompaſſed with water, or which is almoſt an Iſland, except one narrow part, by which it is joined to the *Main-Land*: ~~Such is the Morea which joins to Greece~~; ſuch is *Denmark*, as joining to *Germany*, and indeed *Africa* is but a large Peninſula joining to *Aſia*, as alſo *Jutland* at the top of *Germany*, and *Morea* in *Greece*.

An *Iſthmus* is a narrow neck of Land between two Seas, joining a Peninſula to the Continent, as the Iſthmus of *Darien* or *Panama*, which joins *North* and *South America*: The Iſthmus of *Corinth*, which joins the *Morea* to *Greece*: The Iſthmus of *Sues*, which joins *Africa* to *Aſia*.

A *Promontory* is a hill or point of land ſtretching out into the Sea: It is often called a *Cape*, ſuch is the *Cape of Good Hope*, and *Cape Verd* in the South of *Africa*; the *Land's End*, and the *Lizzard Point* are two Capes at the Weſt of *England*; *Cape Finiſterre* on the Weſt of *Spain*, &c.

A *Coaſt* or *Shore* is all that Land that borders upon the Sea, whether it be in Iſlands or Continents, as the Coaſt of *France*, the Coaſt of *Barbary*: Hence ſailing near the ſhore is called *Coaſting*.

That part of the Land which is far diſtant from the Sea is called the *Inland Country*: Theſe are the diviſions of the Land.

The Water is divided into Rivers or Seas.

A *River* is a ſtream of water which has uſually its beginning from a ſmall Spring or Fountain, whence it flows continually without intermiſſion, and empties itſelf into ſome Sea. But the word Sea implies a larger quantity of water, and is diſtinguiſhed into Lakes, Gulfs, Bays, Creeks, Straits, or the Ocean.

The *Ocean* or the *Main Sea* is a vaſt ſpreading collection of water, which is not divided or ſeparated by Lands running between: Such is the *Atlantick* or *Weſtern Ocean*, between *Europe* and *America*: The *Eaſtern*, or the *Indian Ocean* in the *Eaſt Indies*: The *Pacifick Ocean* or *Great South Sea*, on the Weſt of *America*, &c.

Note, The various parts of this *Ocean* or *Main Sea*, that border upon the Land, are called by the names of the Lands which lie next to it: So the *Britiſh Sea*, the *Iriſh Sea*, the *Ethiopian Sea*, the *French* and *Spaniſh Seas*.

A *Lake* is a large place of water incloſed all round with Land, and having not any viſible and open communication with the Sea: Such are the *Caſpian Sea*, or *Lake* in *Aſia*; the *Lake Zaire* in *Africa*, (as ſome Maps deſcribe) and many others there are in *Europe* and *America*, and eſpecially in *Sweden* and *Finland*, and on the Weſt of *New England*: Such alſo is the Lake or Sea of *Tiberias* in the Land of *Canaan*, and the *Dead Sea* there, which we read of in Scripture.

A *Gulf* is a part of the Sea that is almoſt incompaſſed with Land, or that runs up a great way into the Land.

If this be very large it is rather called an *Inland Sea*: Such is the *Baltick Sea* in *Sweden*, and the *Euxine Sea* between *Europe* and *Aſia*; the *Ægean Sea* between *Greece* and *Leſſer Aſia*; and the *Mediterranean Sea* between *Europe* and *Africa*, which is often in the Old Teſtament called the *Great Sea*.

If it be a leſs part of the Sea thus almoſt incloſed between Land, then it is more uſually called a Gulf or Bay: Such is the Bay of *Biſcay* between *France* and *Spain*: Such is the *Gulf of Venice* between *Italy* and *Dalmatia*: The *Arabian Gulf*, or the *Red Sea* between *Aſia* and *Africa*: The *Perſian Gulf* between *Arabia* and *Perſia*: The Gulf or Bay of *Finland* in the *Baltick Sea*.

If it be but a very ſmall part, or as it were an Arm of the Sea that runs but a few miles between the Land, it is called a Creek, a Haven, a Station, or a Road for ſhips; as *Milford Haven* in *Wales*; *Southampton Haven* in *Hampſhire*, and many more in every maritime Country.

A *Strait* is a narrow part of the Ocean lying between two ſhores, whereby two Seas are joined together, as the *Sound*, which is the paſſage into the *Baltick Sea* between *Denmark* and *Sweden*: The *Helleſpont* and *Boſphorus*, which are two paſſages into the *Euxine Sea*, between *Romania* and the *Leſſer Aſia*: The *Straits of Dover*, between the *Britiſh Channel* and the *German Sea*;

and the *Straits of Gibraltar* between the *Atlantick* and the *Mediterranean*, though the whole *Mediterranean Sea* is ſometimes called the *Straits*.

If we compare the various parts of the Land with thoſe of the Water, there is a kind of analogy or reſemblance of one to the other. The deſcription of a Continent reſembles that of the Ocean, the one is a vaſt tract of land, as the other is of water. An Iſland incompaſſed with water reſembles a Lake incompaſſed with land. A Peninſula of land is like a Gulf or Inland Sea. A Promontory or Cape at Land is like a Bay or Creek at Sea, and an Iſthmus, whereby two lands are joined, has the ſame relation to other parts of the Earth as a Strait has to the Sea or Ocean.

Let us now take notice by what Figures the various parts of Land or Water are deſcribed in a Map, and in what manner they are repreſented.

Sea is generally left as an empty ſpace, except where there are Rocks, Sands, or Shelves, Currents of Water, or Wind deſcribed.

Rocks are ſometimes made like little pointed things ſticking up ſharp in the Sea. *Sands* or *Shelves* are denoted by a great heap of little points placed in the ſhape of thoſe Sands, as they have been found to lie in the Ocean, by ſounding or fathoming the depths. *Currents of Water* are deſcribed by ſeveral long crooked parallel ſtrokes imitating a Current. The *Courſe of Winds* is repreſented by the *heads* of *Arrows*, pointing to that Coaſt toward which the wind blows.

The *Land* is divided or diſtinguiſhed from the Sea by a thick ſhadow, made of ſhort ſmall ſtrokes to repreſent the Shores or Coaſts, whether of Iſlands or Continents, *&c.* and it is uſually filled with names of Kingdoms, Provinces, Cities, Towns, Mountains, Foreſts, Rivers, *&c.* which are deſcribed in this manner, *viz.*

Kingdoms or *Provinces* are divided from one another by a row of ſingle points, and they are often painted or ſtained with diſtinct colours. *Cities* or *Great Towns* are made like little houſes with a ſmall circle in the middle of them. *Leſſer Towns* or *Villages* are marked only by ſuch a ſmall circle. *Mountains* are imitated in the form of little riſing hillocks. *Foreſts* are repreſented by a collection of little Trees. *Small Rivers* are deſcribed by a ſingle, crooked, waving Line; and *larger Rivers* by ſuch a waving or curling double Line made ſtrong and black. The mouths of large Rivers, where they empty themſelves into the Sea, are repreſented ſometimes as currents of Water, by ſeveral parallel crooked Lines.

I ſhould add this alſo, That in large Maps you find the *Mariner's Compaſs* figured in ſeveral parts, and the lines of it are drawn out to a great length toward all parts of the world, on purpoſe to ſhew how any part of the Earth or Sea ſtands ſituated with regard to any other part; and this is called its *Bearing*, by which you may know what places bear *Eaſt*, *Weſt*, *North* or *South* from the place where you are, or at what other intermediate points of the Compaſs they lie. The North is generally deſcribed by a *Flower de Luce*, and the Eaſt frequently by a Croſs.

Maps are generally ſo formed as to have the North juſt ſtanding before the face: Then the Eaſt is at the right hand, and the Weſt at the left: And thus uſually the names and words are written to be read from the Weſt to the Eaſt. This is obſerved in large Maps, and it ſhould be the ſame in ſmall ones; for when a Map of a Country is drawn in any other form, ſo that the North does not lie juſt before us, and the Eaſt to our right hand, it gives great confuſion to the learner, and ſometimes confounds the eye and imagination even of perſons ſkilled in Geography.

OBSERVATIONS.

The Land we inhabit affords the ingenious and philoſophic mind infinite matter for contemplation. The ſeveral ſorts of valuable Metals, precious Stones, and many other materials which are conſtantly imployed for our uſe, and were deſigned to be a never-failing treaſure for the ſervice of all ſucceeding ages; Theſe are carefully locked up in the vaſt ſtore-houſes under our feet, where we are ſure to find them in all caſes of neceſſity. Providence has ſo wiſely ordered it, that they are not buried at ſuch a depth as to make them inacceſſible by us, but at a proper diſtance below the ſurface.

It is certain that the Omnipotent might have placed all theſe riches on the external parts of the Earth, to be near at hand and ready to be employed on all occaſions. But then the vaſt quantities of them would have almoſt covered the Earth, whereas now the ſurface of the Earth is diſengaged of thoſe embarraſſments which would otherwiſe obſtruct all Huſbandry. Beſides, where there not proper coats of earth above theſe materials, the ſoil could not bring forth proper proviſions for the uſe of man and beaſt. But by this piece of natural economy, we enjoy great advantage; the external parts of the ground yielding us proper crops, and the internal furniſhing us with variety of rich materials abſolutely neceſſary to Man in his needy ſtate, uſeful to procure him a decent and commodious habitation, and alſo to ſupply his other exigencies. Nor are the vaſt Mountains which are ſcattered about the face of the Earth to be looked upon as ſo many ſhapeleſs protuberances, placed at random without deſign or intention to produce any advantage to mankind; without the aſſiſtance of Mountains in the hot dry Continents, mankind, animals, and plants, muſt die for want of moiſture; for without them there can be no Fountains, Springs, or Rivers for the ſupport of needy life. Their tops are deſigned to collect the Vapours that fluctuate in the Atmoſphere; the intermediate ſpaces betwixt their ſummits are ſo many Baſons prepared to receive the rains that falls into them, by the aſſiſtance of thoſe tops; their internal parts are ſo many common Store-houſes or Reſervoirs of water for our uſe. As for the Rains that deſcend immediately upon the plains, they either ſoon run off them or evaporate; whereas Mountains feed them with conſtant ſupplies, as the All-wiſe Creator has contrived ſuch vaſt Magazines in the Clouds above them, from which he ſhowers down his treaſures of water upon their ſummits, which afterwards deſcend from ſtory to ſtory, diffuſes its refreſhing ſtreams over the fertile Plains below, giving life and verdure to the Plants and Herbs, and beautifies and inriches the whole Earth.

Beſides theſe ineſtimable benefits, we receive from the Mountains in thoſe Springs and Rivers which diſtil from them, they are a refuge of an infinite number of animals of great utility, which feed upon them, freeing us from all care and charge about their maintenance: nor are the Hunters the only ſet of men that pay their viſits to theſe Mountains when in purſuit of their game; but hither alſo the Herbaliſt comes to ſeek for wholeſome ſimples, which either are not to be found elſewhere, or at leaſt thoſe that grow here are in greater perfection, and have a more medicinal virtue than thoſe planted in Gardens.

The extenſive Meadows which are diſperſed over the face of the Earth, are in reality, the places where Nature has ſhewed herſelf moſt benevolently complaiſant to Man; here ſhe exhibits at once, in a delightful variegated ſcene, the greateſt beauty and fertility together. But the chiefeſt benefit we reap from the Meadows is, that it does, at its own expence, afford proviſion for thoſe animals whoſe ſervice we ſtand in ſo much need of.

How graceful an appearance does the courſe of a River make in the works of Nature; how uſeful to needy creatures; every country ſets a high value upon the River it is enriched with, while thoſe are much diſtreſſed that are deprived of ſo great a bleſſing. In all Continents, and even in the ſmalleſt Iſlands, there are Mountains at different diſtances from each other; ſome higher and others lower, from which there lies a gradual deſcent to the Shore; the ſources of Rivers being purpoſely lodged in the bowels of thoſe eminences, that the Waters by having a proper deſcent may be thrown into the Sea.

The vaſt and prodigious cavity which we call the Channel of the Ocean runs quite round the Globe, and reaches, as may reaſonably be conjectured, from Pole to Pole, and is in many places unſearchably deep; and from the teſtimony of Mariners, there are in it under water Mountains and Vallies, Rocks and ridges of Rocks, as upon the Land. When we preſent this ſtrange Gulph to our imagination, emptied of its Waters, naked and gaping at the Sun ſtretching its jaws from one end of the Earth to another, with what amazement ſhould we ſee it under us like a wide bottomleſs Pit. There are alſo Caves and hollow paſſages running into the very bowels of the Earth, by which the Seas communicate one with another, and with ſubterraneous Waters, thoſe great Whirlpools that are in ſome Seas which ſink into them and overwhelm whatever comes within their reach, ſhew that there is ſomething below that ſucks from them in proportion, and drinks up the Sea as the Sea drinks up the Rivers.

This Element is ſubject to every little impreſſion from the Winds which act upon it, ſo that we find it almoſt perpetually changing its form. Sometimes you will perceive an univerſal calm, its waters ſtill, its ſurface appearing like a flattering glaſſy plain, reflecting another Heaven, with its Sun, its Azure, and its Clouds. On a ſudden you may perceive it grow angry and boiſterous, opening its wide jaws into a terrible abyſs, or with proud billows daſhing the very Clouds: Some Waves breaking with great violence againſt the ſhores, cauſing great tumult and confuſion to the poor diſtreſſed Mariners amidſt thoſe mountains of Water, lamenting their ſad condition; in the midſt of ſuch a diſmal ſcene we could expect nothing leſs than a fatal deluge, where it not that the ſame Almighty hand that lifted up the Waters thereof, has ſet bounds which it cannot paſs; yet even the fierceſt Storms become the obedient Miniſters of this ALMIGHTY.

There is a remarkable motion of this Element well worth our notice. The water of the Ocean flows in, generally ſix Hours together, from the Southern parts towards the Northern parts, and riſes on the Coaſts more or leſs, this we call Flood; when it is in its greateſt height, or high water, it remains at that pitch about one quarter of an hour, and then retires, continuing to decreaſe ſix Hours; and after remaining at its loweſt Ebb about one quarter of an Hour, it makes again to Land. But what occaſions thoſe Tides, perhaps may be unknown to my younger Readers. I ſhall therefore make a ſmall digreſſion to give the great Sir *Iſaac Newton*'s opinion of this very curious natural phænomenon.

SECTION II.

Sir Iſaac Newton*'s Theory of the Tides.*

THE *Tides* are occaſioned by the action or [*] attraction of the *Moon* upon the Waters. By the *Tide* we underſtand the Ebbing and Flowing of the Sea, which twice happens in the time of 24 hours and about 50 minutes. The *Tide* is regular, though it doth not happen at the ſame time, nor after the ſame manner in all places; for the Sea ſwells with us as oft as the Moon paſſeth our Meridian, whether above or under our *Horizon*; and it falls again when the *Moon* is on the *Horizon*, whether it riſeth or ſets; for we find that the Sea in it's motion keeps a proportion of time with the Moon, for as the Moon riſeth every day three quarters of an hour and five minutes later, ſo at the ſame interval doth the Sea riſe. That part of the Sea which is directly under the Moon will be more attracted by it than the reſt: there the Ocean muſt ſwell or riſe, and the waters will run from other parts thither. But from hence it will not follow that there ſhould be *Tides* produced in Rivers, and in Land and Sea Lakes, &c. of little or no breadth, becauſe they are ſo narrow that the Moon cannot act ſtronger on one part than on another; and thus, there being no difference of attraction, there is no reaſon why one part ſhould ſwell or riſe more than another, for the attraction being equal, the water cannot ſhift or move from one place to another ſo as to cauſe a flux or reflux.

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[*] The Laws of common Attraction are, that *it decreaſes as the ſquare of the diſtance between the center of the attracting bodies increaſe*. Thus a body at the ſurface of the Earth, which weighs ten pounds, if it was placed 4000 Miles above the ſurface of the Earth, it would weigh four times leſs; if double that diſtance, or 12000 Miles from the center, nine times leſs, &c. Bodies attract each other with forces proportionable to the quantities of matter they contain, for all bodies are obſerved to fall equally faſt in *vacuo*; as a feather and a guinea.

If the Earth and Sea was not affected by the actions of the *Sun* and *Moon*, it is not to be doubted but the Ocean would continue in a perfect ſtagnation, always at the ſame height, without ever ebbing or flowing; but it being demonſtrated that the *Sun* and *Moon* have a like principle of gravitation towards their center, and that the Earth is within the activity of their attraction, it will plainly follow that the equality of the preſſure of gravity towards the center will thereby be diſturbed; and though the ſmallneſs of their forces, in reſpect to their gravitation towards the Earth's center, render them altogether imperceptible by any experiment we can deviſe, yet the Ocean being fluid, and yielding to the leaſt force, by its riſing ſhews where it is *moſt* attracted, and by its ſinking ſhews where it is *leaſt* attracted. Thus as the *Tides* are occaſioned by the action of the *Moon* upon the Waters, if ſhe were brought within thirty Semidiameters of the Earth to its center, the *Tides* muſt be attracted or ſwell to a prodigious height. All the low countries near the Sea-coaſt would be rendered uninhabitable, the Sea for many miles overflowing them every time the Moon paſſed our Meridian either above or below. Our *Tides* which now riſe to nine or ten feet, would then ſwell to ſixty-eight, and in many places to a greater height. We can ſcarce figure to ourſelves the impetuoſity of ſuch of ſuch a heap of Waters, ſetting in ſucceſſively from the Ocean on the Coaſt, and falling back with equal fury. The *Tides* are greateſt of all above the Equator or middle of the Earth; for the greater the circle in which the *Tides* revolve, the greater will be their agitation; and was the Moon placed in the Pole, the *Tide* would remain immoveable about that Pole. Nor are the *Tides* always largeſt preciſely at the time of the new and full *Moons*; by reaſon of the water's *Libration*[*], thoſe *Tides* are ſomewhat changed, being greateſt about three *Tides* later. For as the Moon goes eaſtward round her orbit in a month, and the Earth turns eaſtward round its axis every 24 Hours, thus the Moon makes *part* of a revolution in the time that the Earth makes a *whole* rotation, and therefore the Earth muſt turn as much more than round its axis, before the ſame place can come even with the Moon again, as the Moon has advanced in her orbit during that interval of time.

Wherever the Moon is, by its attractive quality, it always draws the water towards it, which forms an oval; and the Moon ſhifting her poſition as ſhe turns round the Earth once a day, this oval of water ſhifts with her, occaſioning thereby two Floods and Ebbs, obſervable in each twenty-five Hours. And where the Moon is vertical, or in the Meridian, there the *Tides* are higheſt; but when the Moon is in the Horizon, the *Tides* are then loweſt. *See the Figure, Page* 16.

It ſhould further be obſerved, that the different poſition of the Moon in her orb makes ſome difference in the *Tides*; becauſe, in the diurnal revolution of the Moon, that *Tide* of the two ought to be the greateſt, in which the Moon is neareſt the [†] *Zenith* or *Nadir* of the place; therefore with us, the Moon being neareſt our *Zenith* in the Northern Signs [‡] when

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[*] What is meant by this Libration of the Waters is, that although the *action* of the *Luminaries* ſhould ceaſe, yet the flux and reflux of the Sea would for ſome time continue (owing to its firſt great agitation). This conſervation of the impreſſed motion diminiſhes the difference that otherwiſe would be between two conſequent *Tides*, and is the reaſon why the higheſt *Spring Tides* are not preciſely on the *new* and *full Moons*, nor the *Neaps* on the *Quarters*; but generally they are the third *Tides* after them, and ſometimes later.

[†] *Zenith* means over our head, *Nadir*, beneath our feet.

[‡] The North Signs are

Aries.	*Taurus.*	*Gemini.*	*Cancer.*	*Leo.*	*Virgo.*
♈	♉	♊	♋	♌	♍

above the *Horizon*, muſt then cauſe the greateſt of the two *Tides* when ſhe paſſeth our Meridian. But being neareſt the *Nadir* when in the Southern Signs *, ſhe makes the greateſt tide here when ſhe paſſeth the oppoſite Meridian below the Horizon. The *Spring Tides* upon the *New* and *Full* Moons, and the *Neap Tides* on the quarters, are occaſioned by the attractive force of the *Sun*, in the *new* and *full*, conſpiring with the attraction of the Moon, and producing a ſtrong *Tide* by their united forces; whereas in the quarters, the *Sun* raiſeth the Water where the Moon depreſſes it; and on the contrary, ſo as the *Tides* are made only by the difference of their attraction. It has before been obſerved, that the Moon, by attracting the Waters underneath it, occaſions thoſe Waters to riſe above the other parts: Thus there is always a ſwell of Waters under the Moon of a *ſpheroidical* form (called high Water) by which we ſhall explain why the *Equinoctial Spring Tides* in *March* and *September*, are the *higheſt*, and the *Neap Tides* at that time the loweſt, which proceeds from the greater agitation of the Waters; for at this time the Moon, at its *new* and *full*, as likewiſe the Sun, are both in the Equator, which is the largeſt circle, and in the middle of the Earth. Thus when this fluid ſpheroid (or *Tide*) revolves round the greateſt circle of the Earth, it muſt be more agitated than when it turns about in a leſſer circle; it being plain, that if the Moon was conſtituted in the Pole, and there ſtood, that the Spheroid would have a fixt poſition, and that it would be always *high water* under the *Poles*, and low water every where under the *Equator*; and, therefore, the nearer the Moon approaches the Poles, the leſs is the agitation of the Ocean; which is of all the greateſt when the Moon is in the Equator, or fartheſt diſtant from the *Poles*. Whence the Sun and Moon being either in conjunction or oppoſition in the *Equator*, produce the greateſt *Spring Tides*; and the ſubſequent *Neap Tides*, being produced by the *Tropical Moon* in the quarters, are always the *leaſt Tides*; whereas in *June* and *December*, the *Spring Tides* are made by the *Tropical* † *Sun* and

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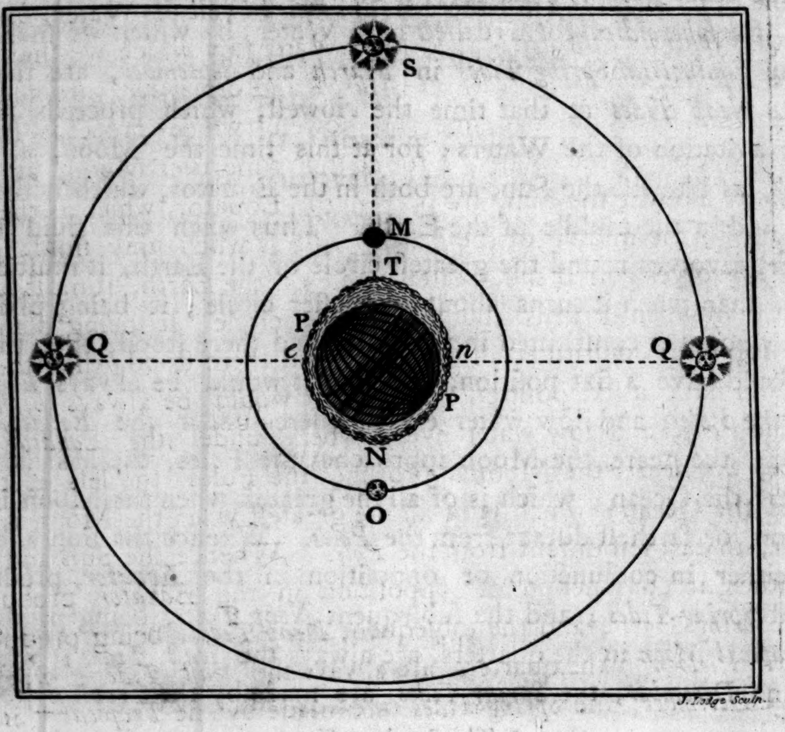
* The Southern Signs are

Libra.	*Scorpio.*	*Sagittarius.*	*Capricorn.*	*Aquarius.*	*Piſces.*
♎	♏	♐	♑	♒	♓

† Tropical Sun and Moon is when either of thoſe Luminaries are in the Signs of *Cancer*, or *Capricorn*. The Sun always enters *Cancer* the 21ſt of *June*, and *Capricorn* the 22d of *December*, which is the Sun's greateſt Northern and Southern declination, being in both theſe Signs at its greateſt diſtance from the Equator, conſequently its action upon the *Tides* leſs powerful.

Moon, and therefore leſs vigorous, and the *Neap Tides* by the *Equinoctial Moon*, and therefore the ſtronger. Hence it happens that the difference between the *Spring* and *Neap Tides* in theſe Months is much leſs conſiderable than in *March* and *September*, and the reaſon why the higheſt *Spring Tides* are found to be rather before the *Vernal*, and after the *Autumnal* Equinox, viz. in *February* and *October*, than preciſely upon them is, becauſe the *Sun* is nearer the Earth in the Winter months, and by that means has a greater effect in producing the *Tides*.—Attention to the following Plate will furniſh you with an accurate idea of this fine effect of Nature in the *Flux* and *Reflux* of the Sea.



An explanation of the above figure of the TIDES.

C the Earth ſurrounded by water P T N—M the Moon in conjunction with, and O in oppoſition to the Sun in S, and in her quadratures from the Sun in Q. Now it is plain the part of the Ocean T to which the Moon M is perpendicular will gravitate to the Moon more than any other parts of the Hemiſphere *e* T *n*, and therefore the water in that part will become lighter than uſual, and ſo will ſwell and riſe up towards the Moon. On the contrary, the water in N being moſt remote from the Moon M will be leſs attracted or gravitate leſs toward the Moon than any other part of the Land or Sea in the Hemiſphere *e* N *n*, and therefore will keep at fartheſt diſtance from the Moon, or which is the ſame thing, it becomes lighter than uſual, and ſwells on the part N contrary to the Moon M. By this means the Ocean muſt of neceſſity conform itſelf to an oval figure whoſe longeſt Diameter is T N, and the ſhorter *e n:* now becauſe the Tides at T and N are exiſtent both at the ſame time, and oppoſite to each other, it is evident, they following the daily courſe of the Moon, that they muſt conſtantly ſucceed each other under every Meridian at the diſtance of twelve hours time, and therefore twice each day as we ſee they do.

A God, therefore a Providence, was an argument of the Stoics, the *univerſal harmony* of things ſhews that they are all formed by the Deity and under his direction. The mutual gravitation or attractions of all Bodies which is not eſſential to matter, is a proof that an immaterial living mind informs and actuates the dead *matter*, and ſupports the frame of the world. We are therefore to conſider mankind as the family of God living under his continual care and inſpection, and accountable to him for all their actions.

SECTION III.

A philoſophic definition of the Earth *and* Sea.

THE benefit which God deſigned for man by the Tides in giving a perpetual motion to the Waters, was to prevent their corrupting, and thereby breeding any infection that might ariſe from too long a ſtagnation of them. He has not committed this truſt to the uncertain care of the Winds, which he appointed to purify the air we breathe, and to facilitate the productions of the Earth by the diverſity of its impreſſions and influences; though the Winds are not leſs uſeful upon the Sea in tranſporting our merchandize with more eaſe and expedition than the ableſt horſes could poſſibly do by Land. Yet their blaſts are very uncertain, and oftentimes ſucceeded by long calms which would ſoon breed putrefaction in the Sea, that great receptacle into which all the ſinks and drains of the Earth diſcharge themſelves. God has been pleaſed to ſuperadd to thoſe irregular and interrupted purgations of the Winds, theſe diurnal helps of the flux and reflux of the Tides, which cauſe the Rivers alſo to flow back to a certain diſtance, by which increaſe of waters large Ships of burden are brought up to capital towns, which without this flowing of the Rivers would be impracticable.

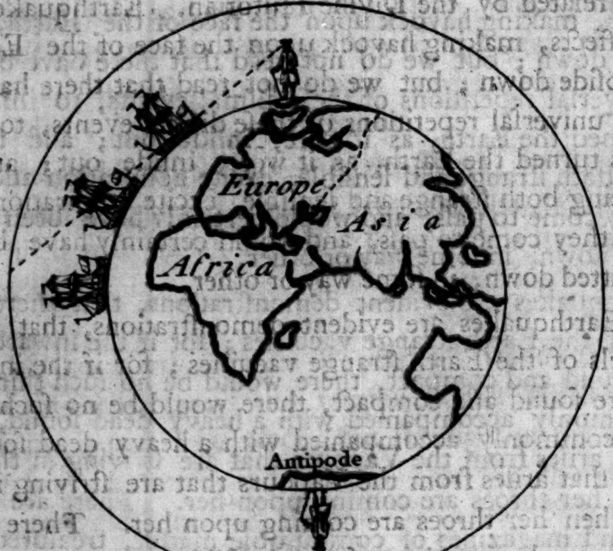
If we could deſcend into the bowels of the Earth, we ſhould there ſee dark chambers and apartments, ſtrange ſubterraneous paſſages, holes and caverns, ſome filled with ſmoak and fire, ſome with water, and ſome with vapour and mouldy air; little brooks running murmuring through the dark grottos. There alſo appears a ſurprizing mixture of ſubſtances in the internal parts of the Earth; maſſes of petrified wood, brick, wrought metals, beds of ſea-ſhells, trees, and marine bodies buried under great ruins; and theſe not in particular places, but throughout the whole Earth; not only in the lower grounds, and hillocks near the ſhore, but in the higheſt Mountains far diſtant from the Sea.—We may probably deſire to know how it came to paſs, that thoſe marine animals, which formerly inhabited the great deep, are now found buried under ſeveral layers of Earth, at a conſiderable diſtance from the Sea, and from the ſurface of the Earth: Theſe have been generally thought the effects of ſome great event, ſome terrible change in Nature. The Scripture informs us, that God cauſed an inundation to be brought upon the Earth in the days of *Noah*, for the puniſhment of a wicked World, that overſpread the face of the whole Earth; and in ſuch exceſs, that the Floods over-reached the tops of the higheſt Mountains, the rain deſcending after an unuſual manner, ſo that a general deſtruction and devaſtation was brought upon the whole Earth and its Inhabitants. The amazing agitation and fluctuation of the vaſt Waves, rolling for many months together on the outward frame of the Earth, muſt have made ſtrange havock, levelling vaſt Mountains, and raiſing others. This univerſal diſorder might occaſion that mixture of bones of animals, maſſes of broken metals, and ſundry works of human Art, together with the ſhells and teeth of Fiſhes, and other productions of the Sea. Several parts of the Earth muſt alſo have been undermined by the raging Waves, and the Mountains in many places have tumbled down on the Plains, burying under their ruins thoſe marine bodies, which were intercepted by this fall. Whatever we can diſcover either upon or within the Earth, ſufficiently proves the truth of thoſe facts which are related by the Divine Hiſtorian. Earthquakes indeed produce the like effects, making havock upon the face of the Earth, and turning things upſide down; but we do not read that there have been ſuch frequent and univerſal repetitions of theſe diſmal events, to infer, that they have thus turned the Earth, as it were, inſide out; and things of this nature, being both ſtrange and ſenſible, excite admiration and great attention when they come to paſs, and would certainly have been remembered or tranſmitted down, in ſome way or other.

Theſe Earthquakes are evident demonſtrations, that there are in the very bowels of the Earth ſtrange vacuities; for if the inward parts of the Globe were ſound and compact, there would be no ſuch thing in Nature. They are commonly accompanied with a heavy dead ſound, like a dull Thunder, that ariſes from the Vapours that are ſtriving in the Womb of Nature, when her throes are coming upon her. There are quantities of exhalations, and magazines of combuſtible matter, treaſured up in theſe dreadful hollow paſſages, that are capable of rarefaction and inflammation; and when the Vapours come to be compreſſed, they ſtrive every

way

way to ſet themſelves at liberty, and often break their priſons, or the cover of the Earth that keeps them in, which Earth upon that diſruption falls into the ſubterraneous Caverns. That theſe Caverns and Trains where the Vapours lie, are very large and capacious, we are taught by ſad experience, for whole Cities, Countries, and Iſlands, as *Liſbon*, *Lima*, &c. have been ſwallowed up into them.

To continue our ſurvey of the Earth, we muſt remember that the Land and Water taken together, make one globular body is evident from the many obſervations of perſons ſtanding on the Shore and viewing a Ship departing from the Port. They gradually loſe ſight firſt of the *bottom* of the veſſel, whilſt they can ſtill ſee the *rigging* and *flags* at the top; but as the Ship proceeds on, they loſe ſight of theſe alſo, as if the whole was ſunk into the deep; likewiſe in a Ship making to Land the Mariners firſt deſcry the tops of *Steeples*, *Trees*, &c. pointing above the Water, next they ſee the Buildings, and laſt of all the Shore, which can only be the effect of the Earth's rotundity.



The globularity of the Earth is alſo evidenced in a Lunar Eclipſe, which is occaſioned by the interpoſition of the Earth between the Sun and Moon; the Earth's ſhadow being reflected on the Moon always appears circular, and it is a fact undiſputed, that bodies reflect a ſhadow ſimilar to their own ſhapes; thus a ſquare ſubſtance oppoſed to the light, produces a ſquare ſhadow; a triangular one cauſes a triangle. Now was the Earth a flat extended Plane like a round table, its ſhadow on the Moon would appear like a ſtrait line, as we ſometimes ſee the immenſe Ring which ſurrounds the body of that remote Planet *Saturn*, (although the ſurface of this ſtupendous Ring is much more extenſive than our whole Earth; yet it frequently appears as only a fine line drawn acroſs the body of its Planet.) It is therefore obvious that the Earth's ſhadow being round, the Earth itſelf muſt be globular, and although there are Vallies and Mountains on its ſurface, theſe inequalities are as inconſiderable when compared to the magnitude of the Earth as the little aſperities upon the rind of an Orange, and accordingly we find that Mountains and Vallies upon the ſurface of the Earth cauſe no irregularities in its ſhadow; for in a Lunar Eclipſe the circumference is reflected even and regular, as if it were produced by a body exactly globular.

The Semidiameter of the Earth is above 8000 Engliſh miles, the higheſt Mountain is not four Miles higher than the ſurface of the Sea, which is but a 2000th part of the Earth's diameter; thus it appears that the higheſt Mountain bears no greater proportion to the bulk of the Earth than a grain of duſt does to a common Globe. The roundneſs of the Earth is alſo confirmed by many *Voyages* which have been made about it from *Eaſt* to *Weſt*: Firſt, by *Magellan*'s Ship in the Year 1519, 1520, and 1521, in 1124 Days: By Sir *Francis Drake* in the Years 1577, 1578, 1579, and 1580, in 1056 Days; and by Lord *Anſon*, who on the 15th of *June*, 1744, finiſhed his long Voyage of near four Years; by Commodore *Byron*, Capt. *Wallis*, *Carteret*, &c. and laſtly, by Capt. *Cook*, accompanied by the ingenious Mr. *Banks* and Dr. *Solander*, in the Years 1769, 1770, 1771, who ſeverally circumnavigated the Globe in 1768, &c.

The people who inhabit that part of the Globe exactly under us are called ANTIPODES: their feet are oppoſite to ours; when it is Noon with us, it is Midnight with them, and our Summer is their Winter. The EARTH reſts upon *nothing*, but is poiſed in the Heavens and ſurrounded with a number of ſmall Atoms called the *Atmoſphere* or *Air*, which is gradually more rarefied the higher we aſcend from its ſurface. Its whole height is ſuppoſed to be forty-ſix or forty-ſeven Miles: But on the higher Mountains, as the *Alps* in *Italy*, and the *Andees* in *America*, its ſo very rare or *thin* that we breathe with great difficulty, and very probably at the diſtance of ſix or eight Miles from the Earth, no *Animal* or *Bird* could live.

SECTION IV.

Uſe of the ATMOSPHERE.

PROVIDENCE has not only admirably fitted our Atmoſphere for the reſpiration and nouriſhment of Animals, the growth of Vegetables, the production and propagation of Sounds, but helps alſo to make our habitable Earth that beautiful ſcene of variety which it now is; deprived of the Atmoſphere, the Sun would yield us no light only when we looked full upon him; but if we turned our eyes from him towards any other part of the Heavens, even at bright noon-day, we ſhould ſee the Heavens appear dark and as full of Stars as on a bright Star-light Winter's night, and the various bodies which are upon the Earth, would all without the Atmoſphere appear to us as dark as at midnight. It is eaſy to imagine how much of the beauty of the viſible Creation would be loſt in theſe circumſtances, beſides the inſupportable prejudice to the eyes of all creatures by the ſudden tranſition from pitchy Darkneſs to exceſſive Light; thus wonderfully has the *Alwiſe-contriver* accommodated the Atmoſphere to our uſe, that even the numberleſs ſmall * particles of various kinds which float in the Air, receive the Light from the Sun, and like ſo many ſpecula or Looking-glaſſes, reflect and ſcatter it through the Air, and this occaſions that Light which we ſee in the Day-time, and it is this grand contrivance that enables the Sun to illuminate the whole *Hemiſphere*, not only whilſt he is above our Horizon, but alſo ſome time before his riſing, and thus inſtead of total darkneſs we are favoured with a uſeful morning and evening twilight. The Atmoſphere alſo occaſions a refraction, which preſents us with a ſight of the Sun itſelf about three Minutes and one fourth every morning before it riſes above our Horizon, and alſo as much every evening after it ſets below it, which in one Year amounts to more than forty Hours; and ſo much *Sunſhine* are all the Inhabitants on every part of the Globe bleſſed with more than they could be without ſome ſuch Divine contrivance.

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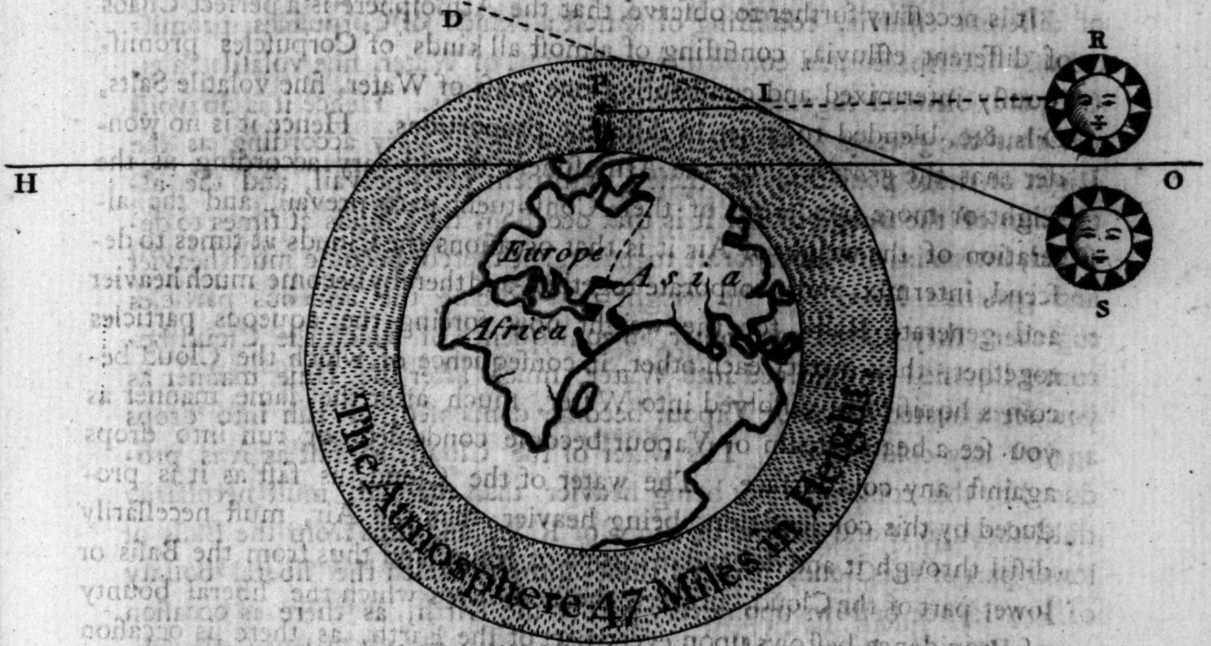
* Thus if the Sun ſhines into a dark room through an hole in a door, or ſhutter of a window, we perceive it in a long ſtream of Light, which appears brighter the fuller the room is of duſt or ſmoke.



This Figure repreſents the Earth ſurrounded with the Atmoſphere: H O is the Horizon of a perſon ſtanding at P; alſo S repreſents the Sun as yet really under the Horizon, from which a ray S I aſcends, and falling upon the upper part of the Air at I, is by the reſiſtance it meets with there bent out of it courſe towards D, into the oblique one I P, and ſo falling upon the eye of the Spectator, he will then ſee the Sun in the direction of this refracted ray at R, a whole breadth, or a little more above its true place.

The following example will alſo ſerve to explain why the Sun appears above the *Horizon* when it is actually below it. Put a Guinea or any piece of money into a Baſon, then retire from the Baſon till you have juſt loſt ſight of the Money at the bottom, then let any perſon gently pour in ſome water, and the Guinea, &c. will very conſpicuouſly preſent itſelf to your ſight; the viſual ray bends on the ſurface of the water and deſcends to the bottom, and thus brings to your ſight the piece in the water. By the ſame rule the *Atmoſphere* preſents us with the image of the Sun when that Luminary itſelf is really under our Horizon.

It is neceſſary further to obſerve, that the Atmoſphere is a perfect Chaos of different effluvia, conſiſting of almoſt all kinds of Corpuſcles promiſcuouſly intermixed and conſtituting one maſs of Water, fine volatile Salts, Oils, &c. blended together in different proportions. Hence it is no wonder that the *gravity* * of the Atmoſphere ſhould vary according as the Light or more ponderous of theſe Conſtituent parts prevail, and the alteration of the weight of Air it is that occaſions the Clouds at times to deſcend, intermix, and incorporate together, and thereby become much heavier and generate Rain, for the weight now forcing the aqueous particles together, they attract each other, in conſequence of which the Cloud becomes liquified or diſſolved into Water, much after the ſame manner as you ſee a heated ſteam or Vapour become condenſed, or run into drops againſt any cold ſurface. The water of the Cloud, as faſt as it is produced by this condenſation, being heavier than the Air, muſt neceſſarily diſtil through it and deſcend in drops of Rain, and thus from the Baſis or lower part of the Cloud, proceed thoſe ſhowers which the liberal bounty of Providence beſtows upon every part of the Earth, as there is occaſion or neceſſity for them, neither have we too much or too little of this ſalutary fluid. Such a juſt and neceſſary diſtillation and diſtribution of waters from the grand alembic of the Atmoſphere could never proceed but from the ſuperintendant wiſdom and direction of that Omnipotent Chymiſt in whoſe hands are all the ſecondary powers of Nature to vary their operations as he ſees conſiſtent with the general good of Mankind. Beſides what we have here mentioned, there are many other ſingular properties in the Air, which will be taken notice of under its proper head: we ſhall now proceed to ſurvey the Earth as it is inhabited by Mankind.

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* What we here mean by *Gravity*, is the weight or heavineſs of the Atmoſphere.

SECTION V.

A Deſcription of GREAT BRITAIN, *&c.*

GREAT BRITAIN, as it is the largeſt in compaſs of all the European Iſlands, ſo it may be juſtly eſteemed the moſt important in *Europe*, and perhaps in the world, with reſpect to its ſtrength both by Land and Sea; its Commerce, as well inland as foreign, and its influence upon other Kingdoms and Nations in moſt parts of the known World. The *Britiſh Empire* is conſtituted of the three kingdoms of *England*, *Scotland*, and *Ireland*, and the ſeveral Plantations of *America* thereunto belonging.

The Iſland of *Great Britain* is large, populous, rich, and fruitful. The Antients eſteemed it ſo conſiderable that they called it *Inſula Magna*; and *Cæſar* boaſted that he had diſcovered another World. It is of a triangular form, the *Land's-End*, the *South-Foreland*, and *Caithneſs*, ſhooting out into ſo many Promontories, and making the corners. A great number of ſmaller Iſlands lie round *Great Britain*; ſome ſingle, as the *Iſle of Wight*, the *Iſle of Man*, &c. others as it were in cluſters, as the *Orkney Iſles*, and other little ſlips, that are ſcattered all along the coaſt of *Scotland*. The three Kingdoms have on all ſides very convenient Harbours, and are accommodated with navigable Rivers in abundance, which convey to them the riches of the Sea, and of foreign nations. The advantage of the Sea ſurrounding them, as it is a ſecurity againſt Enemies, ſo it is alſo againſt the violent colds to which the climate would otherwiſe be expoſed; for the Tides and conſtant motion of the Sea ſends us in a kindly ſort of vapour, which qualifies the natural ſharpneſs of the Air, even to ſuch a degree, that in ſome parts of *France* and *Italy*, they feel more of the Winter than we do in *England*. The ſoil in *England* and *Ireland* doth, in a great meaſure, owe its fertility to the ſame cauſe; the Vapours, not only mollifying the Air, and by that means nouriſhing every vegetable, but they alſo furniſh us with gentle ſhowers in their proper ſeaſons, inſomuch that our Anceſtors believed theſe muſt needs be the *Fortunate Iſlands*, ſo much talked of by the Antients, as having of all others the beſt claim to thoſe natural bleſſings and delights, with which they made them abound. We ſee every day, that the convenient ſituation of any eſtate gives an eſtimate, and raiſes its purchaſe; and, without convenience, life itſelf would be but a mere ſpiration, ſcarce worth the valuing: *England*, then, moſt certainly deſerves to be valued and preferred to all nations on the Earth, having both to ſo great an advantage. It is an Iſland placed as a center to the circular Globe, towards which trade may draw a line from the whole circumference; it is bleſſed with a moderation of every Element; no torrid Zone ſcorches, nor frigid Zone benumbs its Natives, but a medium influence, ſtrengthens, and beautifies its inhabitants, who are of regular ſhapes, neither an unweildy nor pigmy breed, but fit to endure the toils of War, or peaceful labours in the Land; our Climate is ſo moderate that the Sun neither exhales, nor the cold phlegmatiſes the ſpirituous parts, but allows a temperature between both; ſo that our native imaginations are neither too airy for conſideration, nor too dull for invention; its ſoil is mixture and productive, and where barrenneſs appears on the ſurface, the bowels are enriched with valuable Mines. No *Alpine* Mountains, nor *Holland* Bogs, but the Land is charmingly diverſified with ſpacious Plains, beautiful Hills, and fruitful Vallies; ſo that when the parching Sun burns up the higher Lands, the humble Meadows thrive with verdure. Our Paſtures may be juſtly ſtiled excellent, and the verdure of this country ſtrikes foreigners with wonder. And when mighty ſhowers drown the Vales, the Hills grow fruitful by watering; our Lands, when tilled, produce a grateful plenty in return to labour; our trees in general are lofty and well topped, and afford us all the conveniencies we can expect; our kingly oaks ſo firmly rib our ſhips, that our Royal Navy, if duly ſupported by the effects of a proſperous national Commerce, will ever prove an invincible Bulwark to any daring foe: our fruits are pleaſant and uſeful for ſupport: our cattle large, healthy, ſtrong, and numerous, which are as good as the world produces for labour or for food. Our wool is very good, it is the parent of our chief Manufactures, and gives us a plaudit in our Cloths, Baize, Says, Serges, &c. throughout the univerſe. The Weſtern parts of *England* make a great figure in this way, for the Plains in *Dorſetſhire*, *Wiltſhire*, *Glouceſterſhire*, *Somerſetſhire*, and *Hampſhire*, are in a manner covered with Sheep, inſomuch that the people of *Dorcheſter* affirm, that there are always ſix hundred thouſand feeding within ſix miles of that town; yet the Manufacture demands more wool than all theſe ſheep can furniſh, inſomuch that they commonly take thirty thouſand packs from *Ireland*, and very near as much yarn ready ſpun; it has been computed that in thoſe five Counties, there are above one hundred thouſand families maintained by ſpinning, reckoning ſix to a family, excluſive of a Weaver in each, and in many two or three. But it would require a large Volume to run thro' even our capital Manufactures, we therefore ſhall only mention, that to be convinced of the prodigious benefits reſulting from every kind of Manufacture, we need only make a journey into any of the Counties where they flouriſh, and look about us, where we ſhall find the Market Towns thick and yet large, well built, populous, and rich, and Villages within a mile or two of each other. As for inſtance, for twenty miles round *Exeter* in *Devonſhire*; in the neighbourhood of the manufacturing City of *Norwich* in *Norfolk*, where the Stuff weaving is carried on; in *Eſſex*, where the Baize trade flouriſhes; in *Wiltſhire* from *Warminſter* to *Malmſbury*; in the Counties of *Glouceſter* and *Worceſter*, where the white clothing trade is the grand Manufacture: Beſides the many other Counties where the Hardware and Cutlery Manufactories flouriſh, &c. &c. This is ſufficient to ſatisfy an opening mind, as to the truth of all that I have advanced upon this curious and copious ſubject. Our Land is plentifully veined with many noble navigable Rivers, refreſhing the Earth, and affording variety and plenty of fiſh, as well as the conveniency of water carriage, thereby contributing to domeſtic trade, and that happy intercourſe between all parts of the Iſland which communicates its bleſſings, and is thereby the parent of univerſal plenty. It is no wonder, therefore, that ſo amiable an appearance, either excites a ſtrong affection in the natives, or has charms ſufficient to invite over ſtrangers, or to retain amongſt us ſuch as accidentally come hither. There is a natural affection, and (if I may be indulged the expreſſion) a laudable partiality in every Nation for its own Country; and there is no doubt that the people of *Britain* have in all ages had their ſhare of this diſpoſition; and yet, independent of this, we may ſafely affirm, that with reſpect to natural advantages, there are very few Countries that are bleſt with greater than our own. There are indeed warmer and richer Climates, but very few ſo temperate, ſo wholeſome, and ſo pleaſant: The almoſt continual ſpring of *Italy* does not indeed adorn our Fields, but if we want their ſpring, we are alſo without their ſultry Summer. We have no occaſion to pant after the Vallies of *Hæmus*, or wiſh for the deep embowering ſhade; our Summers are moderately hot, and our Winters for the moſt part are very tolerable with reſpect to cold; ſo that we are free at leaſt from thoſe inconveniencies that are produced by either of theſe extremes, and enjoy all, or the greateſt part of thoſe advantages, which are the boaſt of other Climates.—The Sea, by Providence, is a wall which ſurrounds us, to defend us from the Pharaoh that would enſlave us; it is Champion and Servant too: for, by our Ships furrowing its Waves, we ſend our plenty out, and bring the riches of the moſt diſtant parts of the World into our poſſeſſions.—It is very obſervable how Heaven bleſſes us by the courſe of the Wind, that commonly blows weſterly for above half of the year, which makes all our Cape Lands and Bays, oppoſite to the *French* and *Dutch* Coaſts, good roads for our Ships to ride with ſecurity; for we are on the weather, and the *French* on the lee ſhore; beſides our Anchor-hold is much better than either the *French* or *Dutch*, for we have generally a ſtiff clay, chalk, or hard gravel, whilſt the *French* have only hard Rocks or looſe Sands.—Theſe are ſome of the many advantages we enjoy above the reſt of mankind; Nature pours her gifts around us, and we only want a proper temper to enjoy them.—Hail *Britain!* happieſt of Countries! happy in thy Climate, Fertility, Situation, and Commerce; but ſtill happier in the peculiar nature of thy Laws: For let any man converſant in the World, beſtow but a tranſient reflection on the ſtate of mankind throughout the Globe, and he will find that ſcarce any thing prevails, but a confederacy of Civil, Eccleſiaſtical, and Military Tyranny, againſt the Liberties and Properties of the whole human ſpecies; except in the little ſpots called *Great Britain* and *Ireland*, and their dependent Dominions. Examine every State in *Europe*, and you will find the people either exiſt under a ſervile precarious kind of freedom under monarchical Government, or what is worſe, are actually ſlaves in a republic. But But in *England*, where the form of Government is that of a limited Monarchy, the King is greatly reſtrained; which is ſo far from diminiſhing his honour, that it adds luſtre to his crown; for whilſt other Kings are abſolute Monarchs over an innumerable multitude of Slaves, the King of *England* has the diſtinguiſhed glory of governing a *free People*, the meaneſt of whom has a right of protection by the Laws. He has great prerogatives, and an almoſt boundleſs extent of power in doing good, and is, at the ſame time, the ſole obſtruction to the exerciſe of his power, which conſiſts only in his being reſtrained from acting inconſiſtently with his own happineſs, and his People's welfare.—Thus, in Epitome, we ſee what a rich Heireſs, with an immenſe Fortune, we enjoy, by the gift of the great Father of the Univerſe; but we ſhould conſider, when this portion was given, gratitude and duty were expected, that it might deſcend as a jointure to our poſterity.—May the giver of all good things, to whoſe gracious diſpoſition we already owe ſo much, incline us to a grateful ſenſe of his goodneſs, and teach us to make a right uſe of the numberleſs advantages he has put into our power; and may it be the ſtudy of the riſing Generation, to proſecute whatever their Anceſtors have wiſely begun; to amend their errors, and to exceed their endeavours; ſo ſhall we remain a rich, a powerful, and a happy People!

The ingenious Mr. *Thompſon* gives us the following fine Elogium in in praiſe of *England*.

Happy *Britannia!* where the Queen of Arts,
Inſpiring vigour, Liberty abroad
Walks, unconfin'd, even to thy fartheſt Cots,
And ſcatters plenty with unſparing hand.
Rich is thy Soil, and merciful thy Clime;
Thy Streams unfailing in the Summer's drought;

Unmatch'd thy guardian Oaks; thy Valleys float
With golden Waves; and on thy Mountains flocks
Bleat numberleſs; while roving round their ſides,
Bellow the blackening herds in luſty droves.
Beneath thy Meadows glow, and riſe unquell'd
Againſt the Mower's ſcythe. On every hand
Thy villas ſhine. Thy Country teems with wealth;
And property aſſures it to the Swain,
Pleas'd, and unwearied, in his guarded toil.
  Full are thy Cities with the ſons of Art;
And trade and joy, in every buſy Street,
Mingling are heard: even Drudgery himſelf,
As at the car he ſweats, or duſty hews
The Palace-ſtone looks gay. Thy crouded Ports,
Where riſing Maſts and endleſs proſpect yield,
With labour burn, and echo to the ſhouts
Of hurried Sailor, as he hearty waves
His laſt adieu, and looſening every ſheet,
Reſigns the ſpreading Veſſel to the wind.
  Bold, firm, and graceful, are thy generous youth,
By hardſhip ſinew'd, and by danger fir'd,
Scattering the Nations where they go; and firſt
Or on the liſted Plain, or ſtormy Seas.
Mild are thy glories too, as o'er the plans
Of thriving peace thy thoughtful ſires preſide;
In genius, and ſubſtantial learning, high;
For every virtue, every worth, renown'd;
Sincere, plain-hearted, hoſpitable, kind;
Yet like the muſtering Thunder when provok'd,
The dread of Tyrants, and the ſole reſource
Of thoſe that under grim oppreſſion groan.
  Iſland of bliſs! amid the ſubject Seas,
That thunder round thy rocky coaſts, ſet up,
At once the wonder, terror, and delight,
Of diſtant Nations; whoſe remoteſt Shores
Can ſoon be ſhaken by thy Naval arm;
Not to be ſhook thyſelf, but all aſſaults
Baffling, as thy hoar cliffs the loud Sea-wave.

O thou! by whoſe almighty nod the ſcale
Of Empire riſes, or alternate falls,
Send forth the ſaving Virtues round the Land,
In bright patrol: white Peace, and ſocial Love;
The tender-looking Charity, intent
On gentle deeds, and ſhedding tears thro' ſmiles;
Undaunted Truth, and Dignity of mind;
Courage compos'd, and keen; ſound Temperance,
Healthful in heart and look; clear Chaſtity,
With bluſhes reddening as ſhe moves along,
Diſordered at the deep regard ſhe draws;
Rough *Induſtry*; *Activity* untir'd,
With copious life inform'd, and all awake:
While in the radiant front, ſuperior ſhines
That firſt paternal virtue, *Public Zeal*;
Who throws o'er all an equal wide ſurvey,
And, ever muſing on the common weal,
Still labours glorious with ſome great deſign.

Spain, whoſe capital City is *Madrid*, is ſituated about 690 miles South from *London*. The *Spaniards* are men of a piercing wit, and elevated genius; but very little improved by ſtudy or converſation, for want of Schools and Academies, where the Sciences are taught in the modern way. They are admired for their ſecrecy, conſtancy, and patience in adverſity; are very ſlow in determining, but uſually conclude judiciouſly at laſt: They are generous, magnificent, liberal, delicate in the point of honour, ſincere friends, agreeable companions, grave in diſcourſe, great enemies to lying, and extremely temperate in eating and drinking; obedient and faithful to their King, whom they never mention but with the utmoſt reverence, very devout in offices of piety, and very civil to ſtrangers; but much addicted to jealouſy, and naturally of a haughty, proud diſpoſition.

Portugal, of which *Liſbon* is the capital City, lies about 840 miles South-weſt of *London*. The *Portugueſe* are men of a good genius; the nobility and gentry are magnificent, liberal, temperate in eating and drinking: charitable, relieving people in diſtreſs of every nation and religion without exception; but ſomewhat revengful.

France, ofwhich *Paris* is the capital City, lies about 203 miles South-eaſt of *London*. The *French* have a great veneration for their King; they have a genius fit to undertake any thing, whether it be in Learning, Trade, War, or Manufactures; they are very civil, ſprightly, and active; bleſſed with a clear conception, and ready expreſſion; extremely complaiſant and obliging to Foreigners; pleaſing in diſcourſe, replete with vivacity, but too much inclined to foppery in their dreſs, yet they have ſomething of a winning deportment. They have of late advanced Learning to a very conſiderable height, and produced ſeveral Authors, (ſome of the fair ſex) who are now famous through all the learned World, for their ſingular parts: yet the Inhabitants by nature are addicted to, and from cuſtom, have imbibed an habit of flattery and levity.

Italy, whoſe capital is *Rome*, lies about 780 miles South-eaſt from *London*. The *Italians* are exceeding complaiſant, and obliging to each other, and very affable to Foreigners; they are as ſober a people as are to be found in the chriſtian World, though they abound in plenty of choice Wines. They are generally men of wit, but ſomewhat inclined to effeminacy, they have a genius for Arts and Sciences; nor do they want application.

Germany, whoſe capital is *Vienna*, about 650 miles Eaſt of *London*. The natives are allowed to be endowed with ſome very commendable virtues, particularly honeſty, fairneſs in their dealings, and hoſpitality, which the antient, as well as the modern *Germans*, are allowed to have. *Julius Cæſar* informs us, that in his days, their houſes were open to all Travellers, and they look upon it as a piece of injuſtice to affront a ſtranger. They are allowed to be excellent Mechanics and Chymiſts; nor do their Scholars come behind the Mechanics in their unwearied application to their ſtudies. They are indeed, by the *French*, charged with being dull; but if Nature has been bountiful to the *French*, in giving them a ready conception, the want of this in the *Germans* is made up to them in a ſound judgment. As to the honeſty and integrity of the *Switzers*, for which they have been ſo generally applauded, late Writers aſſure us, they do not altogether deſerve ſuch a character at preſent; but, however, are yet brave in Arms, and faithful to their engagements, as Mercenaries, or Allies. The *Hungarians* here are a brave warlike people, wiſe and politic, and zealous aſſerters of the Chriſtian Faith. Theſe are the Dominions of the King of *Pruſſia*, whoſe chief City is *Berlin*, 270 miles North of *Vienna*. They are eſteemed excellent Soldiers, and in all other reſpects, deſerve the ſame character, nearly, with the reſt of the *Germans*.

Holland, or the *United Provinces*, are a confederacy of many independent States. *Amſterdam* the capital, ſituated about 132 miles Eaſt of *London*. The loweſt claſs of the people in this country are induſtrious, but ſlow of underſtanding; not to be dealt with by haſty words, but eaſily managed by gentle expreſſions, and yielding to plain reaſon, if they have time to underſtand it. The trading people in their great Towns are reckoned plain, honeſt dealers (with proper looking after) punctual in every reſpect, pondering and ordering a thing well before they begin it. The Gentry, or Noblemen, are plain, frugal, good ſort of men, and are ſo ſagacious as uſually to acquit themſelves with profit and honour, in the ſervice of their Country. Their general maxim is, let who will be loſers, they will be gainers.

Denmark, whoſe capital is *Copenhagen*, 480 miles North-eaſt of *London*. The *Danes* are the remains of an illuſtrious Nation, which in former times made a great figure in the World. The preſent natives are laborious and content with little; are allowed to be a brave, ingenious people, and equal their neighbours in good qualities.

Norway, belongs to the *Danes*, the chief Town is *Bergen*. *Lapland* and *Iceland* belonging to the ſame King: The *Norwegians* are ſaid to be but an ignorant people; they however are very hardy and laborious, exceeding juſt in their dealings, and obliging to ſtrangers. The *Laplanders* are a very innocent and ſuperſtitious people, ſcarce guilty of any of the vices of their politer neighbours. The *Icelanders* are reckoned a very ignorant and ſuperſtitious people, and value themſelves much for their great ſtrength. This Country is cold, barren, and miſerable, yet Providence has wiſely planted in the human ſpecie ſuch a partiality in each for their own Climate, that the frozen *Laplander* prefers his ſmoak-dry'd hut, and dreary wild, to the moſt luxurious and fertile Meadow in *England*, and will ſay with every nation, *home is home.*

Sweden. The *Swedes*, whoſe country this is, have a ſort of ſtiff gravity; they have a great inclination to make a grand appearance, by which many of them ruin their families; they are a people very religious, and conſtant frequenters of the Church; they are much given to hoſpitality, very affable and civil to ſtrangers. The Nobility, who apply themſelves chiefly to a military life, are famous for their courage and bearing hardſhips. The common Soldiers endure cold, hunger, and hard marches, to admiration, and are more valuable for their courage and obedience, than learning their duty readily. The City of *Stockholm*, is the capital of all this King's dominions, 720 miles North-eaſt of *London*.

Next you have the extenſive Dominions of *Muſcovy*, or *Ruſſia*, whoſe chief Cities are *Peterſbourg* and *Moſcow*; the former 1080 miles North-eaſt of *London*. The temper of the *Ruſſians* is not much admired: They are held to have good parts, und capable of imitating any thing they ſee done: 'tis ſaid they value themſelves in over-reaching each other; for the terms honeſt man and a fool are, with them, of the ſame import: They are ſlothful, proud, and deceitful; and can hardly be brought to learn any art or ſcience without the diſcipline of the whip; are bleſſed with a hale and vigorous conſtitution. However, of late years they are much improved, and the Empreſs takes infinite pains to make her ſubjects as wiſe as they are valliant; they are almoſt perpetually harraſſed with wars and inteſtine broils.

Poland, whoſe capital is *Warſaw*, 766 miles Eaſt of *London*. The genteeler part of the natives are commonly reckoned downright and honeſt, very ſeldom given to the art of diſſembling; they are of a very generous ſpirit, but a great deal of reſpect required. The people in general are very fierce, much inclined to an uncontrouled liberty, or rather licentiouſneſs and petulancy: Wherefore plots and conſpiracies againſt their Kings are frequent among them, whoſe actions they canvas with a great deal of freedom, being always too jealous of the leaſt point of their liberty. They do not want courage, but are more fit to act with a ſudden heat than to endure long the fatigues of War. No rational being would either covet the Throne, the Country, or the People.

The *Turkiſh* Empire, whoſe capital is *Conſtantinople*, is 1300 miles South-eaſt of *London*. The *Turks* are perſons of integrity in their dealings, ſtrict obſervers of their word, very civil to ſtrangers, and extraordinary charitable: They are commended for paying a profound reſpect to every thing that is ſacred, and the ſtricteſt obſervance to the hours of prayer, and the devotion with which they offer them up, but are not without cruelty and much ſuperſtition. The frugality and temperance of the *Turks* are frequently mentioned by Travellers for our imitation; their predominant vices are ſhut up in their Seraglios.

Arabia, whoſe capital is *Mecca*, 2640 miles South-eaſt of *London*. The *Arabians*, near *Muſcat*, are reckoned brave, of a civil and honeſt deportment, to all ſorts of people. The natives in general, in the other parts of this Country, are much taken notice of for their rambling from place to place; and this not in ſmall parties only, but alſo, in many places in great companies, with their Prince at their head.

Perſia, *Iſpahan* is the capital, 2550 miles Eaſt of *London*. The *Perſians* are generally acknowledged to be men of bright parts, and abundance of vivacity, fond of glory, and very courageous; and as they were formerly obſerved to be the moſt civil and obliging of all men, they retain the ſame happy diſpoſition to this day, eſpecially to foreigners, who admire their hoſpitality, benevolence, and the great command they have of their paſſions. They are great enemies to fraud, are meek, peaceable, and modeſt. Amongſt their ſtudies, Moral Philoſophy ſeems to be more cultivated than the reſt. Theſe people ſhew a perfect reſignation under all misfortunes, and ſpeak of death, and ſuffer it, with great evenneſs of temper; as moſt moral virtues ſeem to be deeply impreſſed on their minds.

India, whoſe capital City is *Agra*, is 3780 miles Eaſt of *London*. The inhabitants of this vaſt Empire are to be diſtinguiſhed into *Moors* or *Moguls*, and *Pagans* or original *Indians*. The *Moors* or *Moguls* are a mixture of *Tartars*, *Perſians*, and *Arabs*, whoſe characters may be ſeen under their reſpective heads. The original *Indians*, who are by much the greateſt number of the inhabitants of this Empire, are certainly as polite and ingenious a people, and as peaceable, humble, inoffenſive in their behaviour, as are to be found on the face of the Earth: They are alſo extremely tender and compaſſionate, even to animals and the vileſt inſects. What cruelty and other vices they have, they learnt from the Chriſtians, who have been more their plunderers than protectors. As for courage, they are not very remarkable; however, few people preſerve a more equal temper at the approach of death. The natives of *Siam*, which is a part of *India*, have a ready and clear conception, and their repartees are quick and ſmart; they imitate any thing at ſight very well; and are neither laſcivious or intemperate; nor will wanton diſcourſe paſs for wit, or be taken for ſublimity of genius: They are polite and courteous, and their minds are always calm, being bleſſed with a great command of their paſſions. They are great lovers of their families; their children are ſaid to be very engaging and of a ſweet temper.—The *Tonquineſe*, another people of this vaſt Empire, are courteous and obliging to ſtrangers, eſpecially the trading part of them, and mighty fair dealers; very ingenious and diligent, and patient in adverſity.

China is a vaſt Empire, whoſe capital City is *Pekin*, 4380 miles South-eaſt from *London*. The *Chineſe* are a very polite ingenious people; but it ſeems they uſe ſuch art to conceal their vices, that a ſtranger would be eaſily induced to believe they are all men of ſtrict virtue. They continually apply themſelves to diſcover the inclinations, humours, and tempers of thoſe they have any commerce with; and no people know better how to inſinuate themſelves into the good opinion of thoſe they deal with. Their religion is a ſyſtem of fine animated morality, laid down by their great *Confucius*.

Great Tartary belongs to the *Chineſe*, *Ruſſians*, and ſeveral independent Princes. *Chinyan* is the capital of *Chineſe Tartary*, 4480 miles Eaſt of *London*. *Samarchand* is the chief City of *Independent Tartary*, 2800 miles Eaſt of *London*. *Tobolſky* is the chief City of *Muſcovite*, or *Ruſſian Tartary*, 2412 miles North-eaſt of *London*. We know very little of the character of the inhabitants of this vaſt country, that can be depended on, only that the *Tartars*, in the road from *Tobolſky* to *China*, are reckoned more ſubſtantial than the neighbouring parts, and very hoſpitable. The *Circaſſians* are alſo extremely civil to ſtrangers that travel that way, and will not ſuffer them to pay any thing for the entertainment of themſelves, horſes, or ſervants, but will even contend frequently who ſhall have the honour of treating them. The *Japaneſe*, who are the natives of this Iſland, are reckoned very fair in their dealings, and very ingenious; of quick apprehenſion, and good underſtanding, modeſt and courteous; they are careful to inſtil into the minds of their children a love of glory and virtue, and are not covetous of much riches, contenting themſelves with a competency. They obſerve a decorum in their common converſation, avoiding all looſe or vain expreſſions, and detraction. *Jedo* is the capital City, 4950 miles from *London*. The natives of theſe, called the *Philipine Iſlands*, are an ingenious witty people, civil to ſtrangers, and make a genteel appearance. The *Javaneſe* are very abſtemious, and have the character of being fierce and haughty. The people of *Macaſſar* have excellent memories, and are very quick of apprehenſion. They ſeem to be bleſſed with juſt notions of honour and friendſhip; and there are inſtances of many of them, who have relieved and maintained people in diſtreſs, and even ſuffered them to ſhare their eſtates. They are unhappy in being very ſubject to paſſion; but it is ſoon over, and then they will condemn themſelves for not conquering that weakneſs. There are no people more addicted to arms and hardy enterprizes, enduring fatigues as well as any people whatever. The inhabitants of the Iſland, called *Borneo*, are in general quick of apprehenſion, and extremely inquiſitive, and will learn any thing with a great deal of eaſe. They are held to be people of a very peaceable diſpoſition, and ſeldom or never quarrel. The people of the Iſland of *Sumatra*, do not ſeem to have any thing of a character like ſome of the former; they are ſaid not to want genius, but diligence to apply themſelves to Arts and Sciences. The people of *Ceylon* do not want courage, and are men of quick parts, complaiſant and inſinuating in their addreſs; naturally grave, and of an even temper, not eaſily moved; and when they happen to be in a paſſion, ſoon reconciled again; are very temperate in eating and drinking, and do not indulge in their ſleep.

We come now to *Egypt*, whoſe chief Town is *Grand Cairo*, 1920 miles from *London*, to the South-eaſt. Theſe people do not deſerve ſo good a character as their anceſtors, they being now reckoned very cunning, cruel and luxurious, and far from being famous for their courage or any manly virtue.

The *Moors* of all the country, called *Barbary*, have no better character than the preſent *Egyptians*, being reckoned covetous, unhoſpitable, intent upon nothing but heaping up riches; and yet they are obſerved to be lively and ſharp wits, very dutiful and obedient to their parents, their princes, and their ſuperiors; and recommended for their reverence to God and Religion, and whatever is eſteemed ſacred amongſt them. They will not ſuffer theſe to be burleſqued and made a jeſt of by profane fools, which is too often connived at amongſt Chriſtians, and ſometimes encouraged by thoſe who ought to ſet a better example. The *Arabs*, amongſt theſe people, have always had the character of a thieviſh, pilfering generation, and perpetually led a rambling life: But thoſe who inhabit the Mountains and have had the leaſt to do with the courts, or trade, are much the plaineſt and honeſteſt people. The moſt wretched and abandoned people here, are the *Renegadoes*, who have renounced Chriſtianity, and turned *Mahometans*; theſe prove the moſt vicious, treacherous mortals that the country affords. Here are *Biledulgerid*, *Zaara*, *Negroland*, and *Guinea*; but I find very little ſaid as to the character of the natives, only that thoſe of *Guinea* do not want ſenſe, but employ it to the vileſt purpoſes, in defrauding one another and the *Europeans* that deal with them. But it is thought theſe *Europeans* have, in great meaſure, contributed to make them ſo exquiſite cheats. There is ſtill a more abandoned race in *Guinea* than the Negroes; theſe are the *Mulattoes*, or mixed blood, proceeding from the *Negroes* and *Europeans*, but exceed both in their vices. They are all eſteemed ſuch maſters of their temper, and ſo eaſy in all conditions of life, that no ſudden changes or alterations in their fortune ſeem to diſturb them.

Ethiopia is a vaſt country. The *Abyſſinians* are ſaid to have a great deal of vivacity and natural wit; to be of a teachable diſpoſition, and fond of learning, though they have but few opportunities of improving themſelves. The *Hottentots* here are the lazieſt generation under the Sun: They will rather ſtarve, or eat dried ſkins, or ſhoe-ſoles, at home, than hunt for their food; and yet when they do apply themſelves to the chace, or any other exerciſe, no people are more active, and more generous and hoſpitable; they will ſcarce ever eat a piece of Veniſon, or a diſh of Fiſh, or drink their beloved drams alone, but call in their neighbours to partake with them, as far as it will go: Nor is this generous temper confined to their own countrymen, for they endeavour to ſhew their hoſpitality to the *Europeans*, whom they ſerve with the greateſt fidelity and application, when they contract to ſerve them for wages. We have little or no account of the other parts of *Ethiopia*, as ſcarce any traveller has penetrated into the heart of the country.

African Iſles. The inhabitants of *Madagaſcar* are reported to be a very indifferent ſort of people. The people at the Iſland of St. *Helena*, are the moſt honeſt, inoffenſive, and hoſpitable that are to be met with in foreign parts, of *Engliſh* extraction; having ſcarce any tincture of avarice or ambition: They retain the old *Engliſh* hoſpitality and ſincerity, the unaffected ſimplicity and benevolence, for which our country has been remarkable.

Let us now croſs the vaſt Ocean, and make a viſit to the *Britiſh Empire* in *America*: *Carolina*, whoſe chief town is *Charles Town*, 3450 miles Weſt of *London*. The *Indians* here are a good-natured, generous people, very humane to ſtrangers, patient in want and pain, not eaſily provoked, very quick of apprehenſion, gay of temper, and men of genius and natural eloquence.

The natives of *Virginia* were found, by the *Engliſh*, upon their firſt going amongſt them, to be moſt gentle, loving and faithful; void of all guile and treachery, quick of apprehenſion, and very ingenious; ſome bold, ſome timorous, but all of them cautious and circumſpect. The chief town of *Virginia* is *James Town*, 3210 miles Weſt of *London*.

Baltimore, is the chief Town of the Province of *Maryland*, ſituated 3000 miles to the Weſt of *London*: The natives of this country are allowed to be men of quick and ſprightly parts; they are active, and indefatigable in their warlike expeditions, hunting, and journeys: When any of them are condemned to death, they die like heroes, braving the moſt exquiſite torments, and ſinging even upon the rack.

Philadelphia, 3100 miles Weſt of *London*, is the chief town of *Penſylvania*, whoſe Indians excel in liberality; nothing is too good for their friend;

they are light of heart, and have ſtrong affections: The people in general are ſaid to be perſons of fine natural ſagacity; for a man will deſerve the name of wiſe that outwits them in any treaty about a thing they underſtand. The character of the Indians on the reſt of the Continent, belonging to *Great Britain*, is pretty much the ſame. The *Engliſh* in theſe parts, do, in general, in their behaviour, keep up the deſerved good character of their Countrymen in *Great Britain*.

The Provinces of the *Spaniſh* Empire in *America*. The Indians of *Mexico*, when the *Spaniards* went firſt among them, were a wonderful ingenious, inoffenſive, and hoſpitable people: They did not ſeem to have been defective, either in point of temperance, fortitude, or military ſkill: Both their policy and ſtratagems were exquiſite. They are admired by Travellers for the mutual love and kindneſs that reigns in their families. *Mexico*, the capital City, is about 4800 miles South-weſt of *London*. The *Californians*, have a great deal of vivacity, and are naturally addicted to raillery; as the *Spaniſh* Miſſionaries found, when they began firſt to inſtruct them; for if they committed any error in their language, they jeſted and made ſport with the reverend Fathers; and if at any time they explained any point of Religion or Morality, not conformable to the opinion of the *Californians*, they would wait for the Preacher after ſermon, and diſpute with him, with a great deal of force and wit: If the Miſſionaries could give them good reaſons for what they advanced, they would ſubmit and act accordingly.

The Indians of *Terra Firma*, when the *Spaniards* firſt went among them, were a very good ſort of people: The chief Town of this Province is *Carthagena*, 4320 miles South-Weſt from *London*.

The City of *Lima* is 5700 miles South-weſt of *London*, is the capital of *Peru*; the greateſt part of this City was deſtroyed by an Earthquake, and the Inhabitants ſwallowed up. The Natives of *Peru*, when the *Spaniards* firſt diſcovered them, exceeded moſt Nations in the world, in quickneſs of wit and ſtrength of judgment: They are alſo extremely courteous in converſation, and friendly to ſtrangers: They had attained to a great degree of perfection in

Morality; for their laws, cuſtoms, and doctrine of good manners, were their daily ſtudy, leſſons and buſineſs.

St. *Jago*, the capital of *Chili*, is 5700 miles South-weſt of *London*. The *Chiliſians* are called the braveſt people in the new World, and are remarkable for their wit, patience and fortitude.

The Indians in *Paragua*, are a brave people, and are become ſuch excellent mechanics, that they make Organs, and other muſical inſtruments, as well as thoſe that are carried from *Europe*: Others are Watchmakers, Painters, and Muſicians. The chief town in *Paragua* is *Aſſumption*, 5460 miles South-weſt of *London*. The natives, called *Amazons*, are generally acknowledged to have as much humanity as any people, and a genius for painting and ſome mechanic arts.

The *Portugueſe* Empire in *America*, is called *Braſil*, and its chief City St. *Salvador*, 4260 miles South-weſt of *London*. The Indians are a kind, tractable, and ingenious people; ready to learn any art or ſcience of the *Portugueſe*; and take nothing ſo kindly of the reverend Fathers as the inſtructing their children.

The *French* Empire in *America*, has *Fort Louis* for its capital, is 4080 miles Weſt of *London*. As theſe provinces reſemble, nearly in character, thoſe which lie contiguous, I ſhall not repeat them here, but refer to the character of the inhabitants of *Carolina*, &c. The chief provinces belonging to the *French* are *Louiſiana*, *New France*, and the Iſlands ſcattered up and down.

The Dominions of the *Dutch* in *America*, are *Surinam*, in *Guinea*; *Curaſſoa*, *Bonair*, and *Oraba*, near *Terra-Firma*.

Weſt Greenland is laid claim to by the King of *Denmark*, but it is an inhoſpitable country, upon account of the mountains of Ice and Snow. The *Greenlanders* do not want courage; they abhor theft, murder, and cruelty, and talk much of the immortality of the ſoul; and the Sun is ſuppoſed to be the ſupreme object of their worſhip. *Eaſt Greenland*, is a country ſo cold that no mortals, that we know of, are able to live there. The deſirable curioſities in thoſe high Latitudes or near the North

Pole is the ſource of attraction, and to know whether the axis of the world turns in Water or Earth, with the phænomenon of the Northern Lights, and the practicability of a North-eaſt or North-weſt paſſage.

We learn that a ſimilarity of language, manners and complexion are always to be met with amongſt people inhabiting on the ſame parallels of Latitude. *Otaheite* produces nearly the ſame kind of vegetables, and the inhabitants are nearly of the ſame colour as *Madagaſcar*, as the Latitudes of both thoſe places have an affinity; and thus the moſt Northern parts of *Tartary* very much reſemble thoſe of *Scandinavia* and *Lapland*; there is a certain likeneſs even in their natural curioſities, their ſhell-fiſh are of the ſame ſpecies—there is a great ſimilarity in the one, and ſubterraneous caverns of theſe two places from whence this conſequence may with great propriety be inferred, that the ſame kind of plants and vegetables will grow and flouriſh in places how diſtant ſoever, if they are but ſituated on the ſame parallels of Latitude—a poſition well worth the attention of Naturaliſts of every denomination.

It has been often conjectured that the three vaſt continents of *Europe*, *Aſia*, and *America* are ſo joined as to form but one: taking this for granted, and it will follow, that the whole four continents are united, for it is an unqueſtionable fact, that the continent of *Africa* is joined to that of *Aſia* by the *Iſthmus of Suez*, which ſome have not improbably deemed the *Goſhen* of the ancients. The Eaſtern parts alſo of *European Muſcovy*, join * *Aſia*, and that again in ſome very high Latitudes joins the Northern parts of *America*; from hence it ſhould ſeem, though our diſcoveries have not as yet aſcertained the fact, that there is ſomewhere a junction of the four continents; and this will ſolve the difficulty under which Hiſtorians have laboured, when attempting to account for the manner of peopling thoſe immenſe tracts of Land, which by vulgar error are ſuppoſed to be ſeparated by the Ocean from other continents.

It ſtill remains the opinion of our ableſt Geographers, that although our † adventurers have not as yet been able to diſcover a South continent,

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* In ſailing to *Aſia* what a prodigious compaſs are we forced to fetch about to come at its extreme regions, moſt of which might be ſaved could a paſſage be diſcovered by the North to *Tartary* or *China*.

† Mr. *Banks* and Dr. *Solander*.

tinent, it is by no means deſpaired of as it is generally believed, there is a continent, though perhaps in higher South Latitude than we have yet penetrated. *

Having thus taken a tranſient ſurvey of the ſeveral inhabitants on the ſurface of the Earth, it may be neceſſary to give ſome account of the *motion of the Earth itſelf*, which is the foundation of *Longitude*, and the ſubject of the ſucceeding Section.

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* The Sea and unknown parts of the Earth contain 160,522,026 ſquare miles, the inhabited parts 38,990,569. *Europe* 4,456,065. *Aſia* 10,768,823. *America* 14,110,874. In all 199,512,595, which is the number of ſquare miles on the whole ſurface of our Globe. Thus the ſurface of the Sea is three times as great as that of the Land hitherto diſcovered, and this is pretty evident from a bare inſpection of the Circular Maps, for at one view we ſhall obſerve the *Great South Sea*, *Pacific Ocean*, *Atlantic*, &c. contain more ſpace than all the Land.

SECTION VI.

Of LONGITUDE.

THE Longitude of any place is its diſtance EAST or WEST of any other given place, and what we want is a method of finding out at Sea how far we are got to the Eaſtward or Weſtward of the place we ſailed from; the application of a *Time-keeper* to this diſcovery is founded upon the following principles.—The Earth's ſurface is divided into 360 equal parts (by imaginary lines drawn from North to South) which are called *degrees of Longitude*. The Earth's daily revolution Eaſtward round its Axis is performed in 24 hours; conſequently in that period each of thoſe imaginary lines or degrees become ſucceſſively oppoſite to the Sun, which makes the noon or preciſe middle of the day at each of thoſe degrees, and it muſt follow, that from the time any one of thoſe lines paſſes the Sun till the next paſſes, muſt be juſt 4 minutes; for 24 hours (or 1440 minutes) being divided by 360 will give that quantity. So that for every *degree of Longitude*, we ſail Weſtward it will be noon with us 4 minutes the later, and for every degree Eaſtward 4 minutes ſooner, and ſo in proportion for any greater or leſs quantity. Now the exact time of the day at the place where we are, can be aſcertained by well known and eaſy obſervations of the Sun, if viſible for a few minutes at any time, from his being 10 degrees high till within an hour of noon, or from an hour afternoon: If therefore at any time when ſuch obſervation is made, a *Time-keeper* tells us at the ſame moment what o'clock it is at the place we ſailed from, our *Longitude* is clearly diſcovered. For example, ſuppoſe we ſail from *London* exactly at 12 o'clock at noon, (at which time the Sun is on our Meridian) and proceed by compaſs till after ſome days; we wiſh to know our *Longitude*,—We therefore look at our Time-piece, and find that it is exactly 10 o'clock in the morning; but by obſerving the Sun we diſcover it is noon, or preciſely 12 o'clock; that luminary then being due South, or Meridian heighth, and conſequently at that place makes its mid-day, or 12 o'clock. The Time-piece at this inſtant making it only 10 o'clock in the morning; and the Sun proving it to be 12 o'clock, makes two hours difference between the Sun and Time-keeper, and ſhows that we are two hours * *Eaſtward* of *London*, or 30 degrees *Eaſt Longitude*, which is equal to 1800 miles (reckoning ſixty miles to a degree). The difficulty which formerly aroſe in truly aſcertaining the *Longitude*, was occaſioned by the irregularity of our Watches and Time-keepers, which is now much remedied by that excellent Time-piece contrived by Mr. *Harriſon*, for which his Labours were liberally rewarded by the Government.

SECTION VII.

Deſcription and Explanation of the LONGITUDE DIAL, *with its Uſe. See the Frontiſpiece.*

THE external or outward circle, which is fixed and divided into twice XII, repreſents the 24 hours of Day and Night; the moveable Circle within contains moſt of the capital Kingdoms and Nations of the Earth, deſcribed according to their difference in time from each other; and underneath this moveable circle is a circle of figures deſcribing the LONGITUDE of each place. By lifting up the inward circle, thoſe Longitude figures will be diſcovered exactly under the figures in the Dial; thoſe on the left hand beyond the W, is Weſt Longitude, and all places on the right-hand beyond the E, is Eaſt Longitude; this will appear more evident by bringing *Great Britain* to the upper XII, and holding the Dial in ſuch a poſition *that* its back is to the North, that is, the face of the Dial to front the South; then all thoſe places on the right-hand will be Eaſt of *London*, and all thoſe on the left hand will be Weſt of *London*. The top, which is exact under the figure of the Sun, is always *Noon*; the bottom *Midnight*; the left-hand ſide is *Morning*, the right-hand

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* Had the Time-keeper pointed to two in the Afternoon, it would prove we had been two hours, or 30 degrees *Weſt* of *London* or *Weſt Longitude*.

Evening, as the *figure* itſelf points out. Some of the many uſes of this little machine are as under.

Obſerve by your watch what hour it is; bring *Great Britain* to that hour on the outward circle, then againſt the ſeveral Countries inſerted in the moveable circle, you have the time of *Day* or *Night* at thoſe places at one view.

Thus when it is 12 o'clock at noon with us in *Britain*, 'tis almoſt 12 at the Courts of *Spain* and *Morocco*; a little paſt 12 at *France* and *Negroeland*; about 1 at *Italy*, *Germany* and *Sweden*; 2 o'clock at the reſidence of the *Great Turk* in *Conſtantinople*, and with the *Egyptians*, *Polanders*, &c. 5 in the afternoon at our Settlements at *Bombay* and the *Mogul*'s Empire; 7 at *China*; 12 at night with *New Zealand*, which are nearly our *Antipodes*; 2 in the morning to the inhabitants of OTAHEITE, the late new diſcovered Iſland by the ingenious Mr. *Banks* and Dr. *Solander*; 3 in the morning to thoſe ſailing in the *Great South Sea*; 5 in the morning at *Mexico* or *New Spain*; 7 at *Virginia* and *Peru*; 9 at *Greenland* and *Brazils*, and 11 at the *Canary Iſlands* and *Iceland*.

PROBLEMS *which may be ſolved by the* LONGITUDE DIAL *in the Frontiſpiece.*

PROB. I. When it is 12 o'clock at *London* or any part of GREAT BRITAIN, what hour is it at *Italy*, *Germany*, or *Sweden?* Bring GREAT BRITAIN to the upper XII, which is noon, then find out in the moveable circle, *Italy*, *Germany* and *Sweden*; obſerve the figure to which they point, which will be 1 o'clock, therefore when it is 12 o'clock at *London*, it is 1 o'clock at *Italy*, *Germany* or *Sweden*. *

PROB.

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* To explain this, we muſt remember the Sun is a fixed body, and that the Earth's ſurface is divided into 360 equal parts, by (imaginary lines drawn from North to South) which are called *degrees of Longitude*. The Earth's daily revolution *Eaſt-ward* round its own Axis (as before obſerved) is performed in 24 hours; conſequently in that period each of thoſe imaginary Lines or Degrees become ſucceſſively oppoſite to the Sun, which makes the noon or preciſe middle of the day at each of thoſe Degrees, and it muſt follow, that from the time any one of thoſe lines paſſes the Sun, till the next paſſes, muſt be juſt

4 minutes,

Prob. II. When it is 12 o'clock at *London* or any part of *Great Britain*, what is *then* the hour at * *Turkey* and *Egypt?*

Example. Bring *Great Britain* to the upper 12 o'clock under the Sun, which is noon, you will then obſerve *Turky* and *Egypt* point to 2 o'clock in the afternoon, which is the exact time of day with them when it is 12 o'clock with us, and proves that they have paſt the Sun two hours before us. For inſtance.

Prob. III. When 12 o'clock at *Turky* or *Egypt* what is *then* the hour at *London?*—Anſ. 10 o'clock in the morning.

Example. Bring *Turkey* and *Egypt* to the upper XII, and you'll ſee *Great Britain,* which lies *Weſtward* to point to 10 in the morning. But in two hours, by the turning of the Earth, we in *Great Britain* ſhall be brought under the Sun, which will be 12 o'clock; at the ſame time *Turkey* and *Egypt* will have paſt the Sun two hours, and conſequently 2 o'clock with them.

Prob. IV. When it is 12 o'clock at *Great Britain,* what hour is it then at *Greenland, Brazil,* &c? Bring *Great Britain* to the upper XII, *Greenland* will point to 9 o'clock in the morning; therefore when it is 12 o'clock with us it is only 9 o'clock with the *Greenlanders,* they being

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4 minutes, for 24 hours, or 1440 minutes being divided by 360, will give that quantity. As the Earth continually keeps turning upon its Axis, the velocity of the motion on its ſurface is ſuch, that 60 miles, or one Degree of the Earth, is but juſt 4 minutes in paſſing by the Sun, therefore if one Degree of the Earth requires but 4 minutes to paſs the Sun, in one hour, 15 Degrees of the Earth will paſs that luminary; thus the Earth turning Eaſtward will bring all thoſe places that are 15 degrees *Eaſtward* of us, to the Sun *one hour before us,* and thoſe places that are 30 degrees Eaſtward of us will have the Sun in their Meridian *two hours before us*; and thoſe places that are 45 degrees Eaſtward of us will ſee the Sun riſe *three hours before us,* and have that orb of light in their Meridian, or over their heads three hours before us. But all thoſe places ſituated 45 degrees WESTWARD of us, will not by the motion of the Earth be brought under the Sun till *three hours after us,* nor will they ſee the Sun riſe till *three hours after* that luminary has riſen with us. Thus the inhabitants of *Italy, Germany,* and *Sweden,* being EASTWARD of us, ſee the Sun riſe, and have it in their Meridian before us; but the *Canary Iſles,* and *Iceland* being WESTWARD do not ſee the Sun till after us.

* *Turkey* and *Egypt* are nearly in the ſame degrees of LONGITUDE, and all places that have the ſame Longitude, ſee the Sun exactly at the ſame time.

ſituated 45 degrees to the *Weſt*, or behind us, are not by the rotation of the Earth brought up to the Sun till 3 hours after us.

PROB. V. When 6 o'clock in the evening at *Great Britain*, what is it a clock at *Florida*, *Bengal*, *Tartary*, *New Zealand*, &c?—Bring *Great Britain* to 6 o'clock in the evening, then will *Bengal* and *Tartary* point to 12 o'clock at night—with the inhabitants of *Florida* and *Canada* it will be 12 o'clock at noon, and at *New Zealand* it will be 6 o'clock in the morning, all which the *Longitude Dial* clearly demonſtrates.

PROB. VI. When 1 o'clock in the afternoon at *London*, what hour in the *Mogul*'s Empire? How many miles diſtance from us? and what part of the Globe is it ſituated in? Bring *Great Britain* to 1 o'clock in the afternoon, then will it be 6 o'clock in the evening in the *Mogul*'s Empire; and the difference in time between *London* and the *Mogul*'s Empire being 5 hours, which being multiplied by 15, (the degrees in an hour) gives 75 degrees for the diſtance between thoſe two places, which multiplied by 60, the miles in one degree gives 4500 miles for their diſtance between *London* and the *Mogul Empire*. It is ſituated Eaſtward, which may be told by its having paſt the Sun before *Great Britain*.

PROB. VII. To find all thoſe inhabitants to whom the Sun is any hour *riſing* or *ſetting* in their *Meridian* or *Mid night*—This Problem is more accurately performed for the months of *March* or *September*, when the Sun makes it equal Day and Night all over the world; the Sun riſing at 6 in the morning and ſetting at 6 in the evening.—We will therefore demand to find thoſe inhabitants where the Sun is riſing or ſetting in their Meridian, and at 12 o'clock at night in *London*, on the middle of *March* or *September*. Bring *Great Britain* to the lower XII, which is 12 o'clock at mid-night; then will the Sun be juſt riſing to the inhabitants of *Bengal* and *Tartary* (See Figure VI. in the Dial, and *Morning* over it) it will be in the Meridian, or 12 o'clock at noon, to the inhabitants of *New Zealand*, and the Sun will be juſt declining below the Horrizon, or ſetting to the inhabitants of *Florida* and *Canada*, all which is plainly ſhewn by the Dial.

Prob. VIII. When 5 o'clock in the morning in *Great Britain*, what hour at *China ?*—Anſ. 12 o'clock at noon.

Prob. IX. When 12 o'clock, or mid-night at *China*, what hour at *Great Britain ?*—Anſ. 5 o'clock in the afternoon.

Prob. X. When 12 o'clock, or mid-night at *Mexico*, what hour at *England ?*—Anſ. 7 o'clock in the morning.

Prob. XI. How many miles (in Longitude) is *Sweden* diſtant from *Great Britain ?*—Anſ. 900.

Example. Bring *Great Britain* to the upper XII, you'll obſerve *Sweden* point to one o'clock ; lift up the part where *Sweden* is wrote, and underneath it will be found 15 Degrees, which is the Longitude of *Sweden* : to turn this into miles, multiply it by 60, as 60 miles make a Degree, and it will ſhew you that *Sweden* is 900 miles, or 15 Degrees Eaſt Longitude from *London*.

Prob. XII. What is the Longitude of *Greenland ?*—Bring *Great Britain* to the upper XII, then lift up that part of the Dial on which *Greenland* is wrote, you will there find 45 Degrees, and being on that ſide the Dial where the W is placed, *i. e.* the left-hand ſide, implies it to be 45 Degrees Weſt Longitude: theſe 45 Degrees multiplied by 60, gives 2700 miles, and ſhews *Greenland* to be 2700 miles Weſt of *London*.

Prob. XIII. Required the Longitude of *China*, and in what part of the Compaſs it lies ?—Bring *Great Britain* to the upper XII ; find *China* upon the Dial ; look under it and you'll perceive 105 Degrees, which is the Longitude of *China*, and being on the right-hand, intimates it lies Eaſt ; 105 Degrees multiplied by 60 (the miles in a Degree) gives 6300 miles, therefore *China* is about 6300 miles Eaſt of *London*.

Prob. XIV. Required the Longitude of the new diſcovered Iſland *Otaheite*, with its diſtance in miles from *England*, and its bearings, whether *Eaſt* or *Weſt ?*—Bring *Great Britain* to the upper XII or noon ; *Otaheite* will then point to two o'clock in the morning, which is the difference in time between *England* and *Otaheite*. In this poſition lift up

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the Dial where *Otaheite* is wrote, and you will ſee 150 Degrees under it, and being on the left-hand implies it to be 150 Degrees Weſt Longitude, as may be ſeen by the W under the upper XII. This 150 Degrees multiplied by 60 (the miles in a Degree) give 9000 miles for the Longitude diſtance of *Otaheite* from *London*. It ſhews you it is 2 o'clock in the morning with them, when 12 at noon with us, and alſo ſhews you its bearing is WEST of *England*.

Theſe few Problems may ſuffice, but an infinite number more may be performed by this *Longitude Dial.*

NAVIGATION, and conſequently Commerce, that fountain from which all our opulence and riches flow, in a great meaſure depends upon LONGITUDE, which hath its riſe and principal dependance upon ASTRONOMY. By indefatigable reſearches, Aſtronomers have diſcovered that the Planet *Jupiter* hath the ſame motions as our Earth, that is, it turns upon its Axis, and thus conſtitutes its day and night. This Planet alſo furniſhed with an Atmoſphere, revolves round the Sun as our Earth does, but in a larger Orbit, being more remote from the Sun than we are, is not favoured with ſo large a portion of the Sun's light as our Earth. But to remedy this, Providence has furniſhed *Jupiter* with four Moons that are (by the aſſiſtance of a reflecting Teleſcope) very conſpicuous, which like our Moon eclipſe and are eclipſed: Thus thoſe four Moons of *Jupiter* are ſeen frequently to be eclipſed by their Planet, and this ſcience is of late years ſo much improved, that we are now inabled moſt accurately to calculate the preciſe minute when any of *Jupiter*'s Moons are, or will be eclipſed; and by this very curious phænomenon our Longitude is diſcovered.—For example. Suppoſe I find by Mr. *White*'s *Ephemeris,* that the firſt ſatellite (or Moon of *Jupiter*) will be immerſed into *Jupiter*'s ſhadow (or eclipſed) at 8 o'clock at night in LONDON, on ſome certain day: but being at Sea, I obſerve the immerſion to begin at 10 o'clock the ſame evening, the difference in time, which is two hours, turned into Degrees, allowing 15 for each hour, ſhews that I am 50 Degrees to the EAST, becauſe the time is more than at *London*; had the time been two hours leſs, I ſhould have been 30 Degrees to the Weſt. By this method the

Mariners are enabled to correct their reckoning by theſe Moons of *Jupiter*, which were never heard of or ſeen, till the Teleſcope diſcovered them to *Galileo* on the 7th of *January*, 1610.

SECTION VIII.

Of LATITUDE.

IT has been ſhewn that *Longitude* is the length of the Earth from Eaſt to Weſt, conſequently *Latitude* muſt be its length from North to South, Or, in other words, an arch of the Meridian intercepted between the *Pole* and the *Horizon*, and therefore on the Globes called the *Pole's height*. Latitude in Navigation is the diſtance of a Ship from the Equator, (or middle of the Earth,) either North or South, and is counted on the Meridian, ſo that if a Ship ſails towards the Equator, ſhe is ſaid to *depreſs* the *Pole*. And whenever a Ship ſails to or from the Equator, either North or South, her way thus gained, is called her *difference of Latitude*. But to give a very full explanation relative to the more extenſive meaning of *Latitude*, we are to conſider the true form of our Earth, as round or globular, and likewiſe that there is a bright fixed Star in the North part of the Heavens, which we call the *North Pole*. Now when we are at the Equator, or middle of the Earth, this Star, which never moves, appears in the Horizon or level with the Earth; therefore we then call it no degrees Latitude; the globularity of the Earth occaſions a *ſwell* which makes the *North Pole* at this place appear level with this ſwell of the Earth. But as we travel from the Equator towards the North, we obſerve this Star riſe higher; we are then ſaid to *raiſe the Pole*; but ſhould we turn our backs to it and go beyond the Equator Southward, we ſhould immediately looſe ſight of this Star, as the ſwell of the Earth would be ſo great betwixt this Star and our eye, that it would be totally hid from our ſight, and this is called *depreſſing the Pole*; and here we ſhould be entertained with ſeveral curious Stars, or Conſtellations in the South, which we never can ſee in our Northern Climates, and the more we continue our voyage or journey ſouthward, the more of thoſe Stars would apparently ariſe to our view. But on our return again to the North, we at firſt ſhould loſe ſight of that Star called the *North Pole*, until we came once more to the Equator (which as before obſerved, is the exact middle of the Earth) here we ſhould again juſt obſerve the North-ſtar above the Earth or Horizon; now if we continue travelling 60 miles more Northward, and then take this Star's height by a Quadrant, &c. we ſhall find it one degree high; which is equal to 60 miles, and every 60 miles we travel North, that Star will appear one degree, or 60 miles higher in the Heavens *, and thus having continued our voyage due North for ſome weeks, and are at a loſs to know how far we are got Northward, we again examine the height of this Star, and find it to be 30 degrees above the Horizon; therefore we ſay that we are in thirty degrees North Latitude, which is equal to 1800 miles, and ſhows us to be 1800 miles from the Equator, where we firſt diſcovered the North-ſtar; in a word, every degree the Pole-ſtar ſeems to have advanced in the Heavens, proves that we have advanced ſixty miles Northward upon the Earth, and thus when we arrive in *England*, we obſerve our Latitude is 51 degrees and a half, which is the elevation of the *North Pole* with us, and ſhews we are about 3100 miles from the Equator, or middle of the Earth. Thus alſo we have explained that the Latitude of a place is its diſtance from the Equator towards the *North* or *South Pole*, and is denominated North or South, as the given place is on the North or South ſide of the Equator. The *Poles* are the fartheſt points of the

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* For example. Suppoſe we were to aſcend a high hill, behind which is a Church, when we firſt begin to advance the hill, its ſwell or riſe between us and the Church prevents our ſeeing the building, till we have got half up the hill, and thus raiſed our eye above a level with its top, we then firſt begin to diſcover the ſteeple, as we aſcend the Church ſeems to riſe higher, for now we plainly diſcover the battlements, and when arrived at the top of the hill, the obſtacle between us and the object being removed, the whole body of the edifice preſents itſelf to our view; thus it is evident, every ſtep we made up the hill, we raiſed the Church more and more to our ſight, by leſſening the ſwell of the hill between us; thus we will ſuppoſe the top of the Church the North Star; the hill the ſwell or globularity of the Earth; by aſcending this ſwell we raiſe ourſelves and leſſen its interpoſition, and conſequently gain a compleat ſight of the Church or Star, and this experiment moſt infallibly proves the globularity or roundneſs of our Earth.

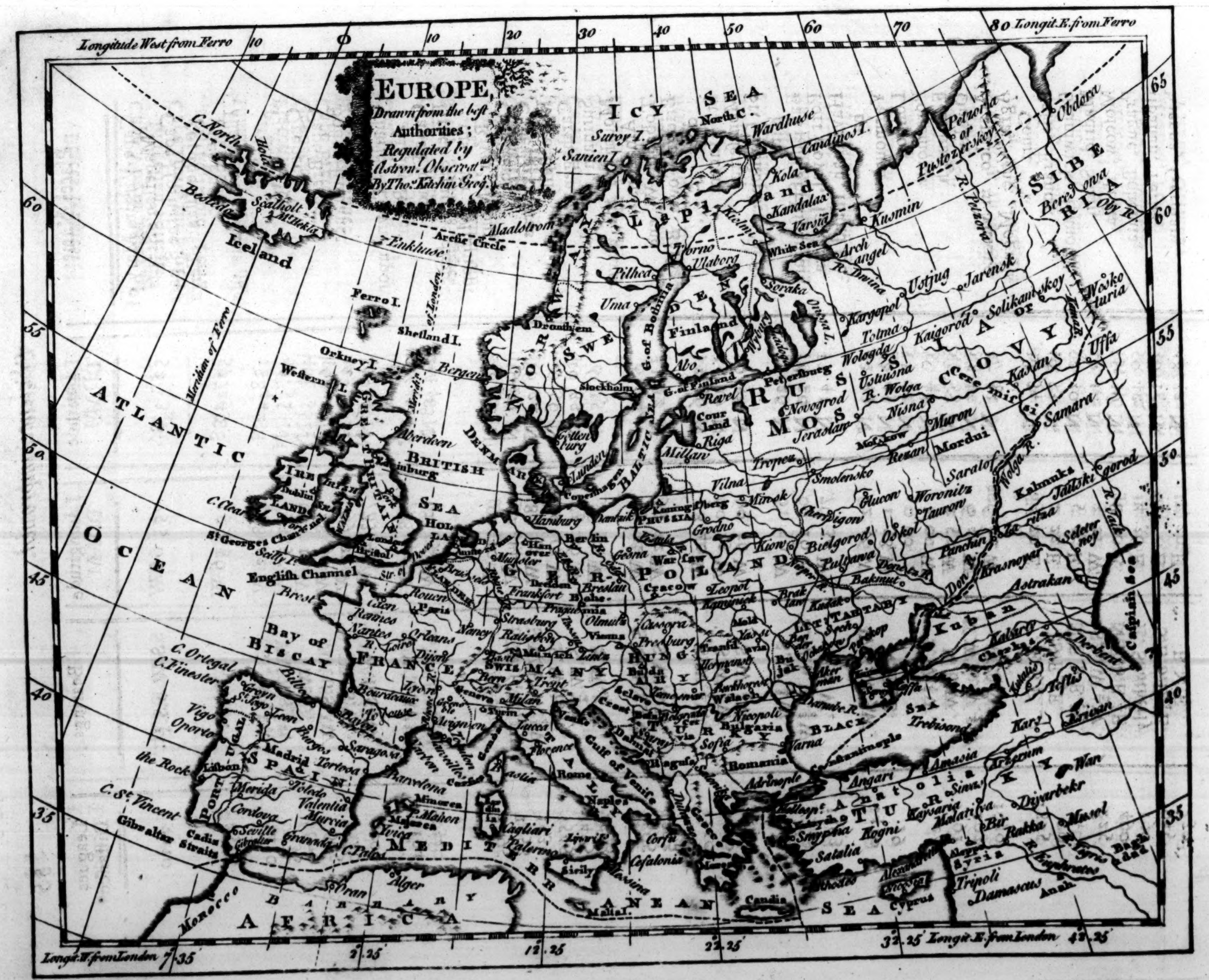
Earth from the Equator, they have the greateſt Latitude, which is 90 degrees, or a fourth part of 360, the whole circumference of the Globe. It is remarkable, that in the height of our Summer, at twelve o'clock at noon, the Sun appears to want but very little of being exact over our heads, and yet the Sun at this time is no farther North Latitude than 23½ degrees, but we are in 51½ degrees North Latitude, conſequently the Sun muſt advance 28 degrees more Northward to be exact over our heads, *i. e.* in our Zenith, which is equal to 1680 miles. This has been, and ſtill may be proved beyond a doubt, for was any perſon to journey towards the Sun full South, and although he every day drew nearer to the Sun, yet he would not have this mighty orb exact over his head until he arrived at *Jamaica*, *Arabia*, the *Mogul*'s *Empire*, or ſome other place in 23½ degrees Latitude, and then he would have the Sun in his Zenith, or exactly over his head, ſo that he would at twelve o'clock in the day caſt no ſhadow. Should we continue travelling until we come to *Bengal* or the Coaſt of *Guinea*, we ſhould then paſs the Sun, and at twelve o'clock at noon, inſtead of looking Southward for the Sun, we muſt look the contrary way, *i. e.* North, and there we ſhould ſee the Sun in his full glory and ſplendour. It is worth attention to remember that in Summer at twelve o'clock in *England*, we are obliged to look full South for the Sun, but at *Barbadoes*, *Bengal*, &c. in that ſeaſon they have no Sun in the South, but are obliged to look to the North for it, for then every day at twelve o'clock the Sun is full North with them, but in Winter they ſee the Sun as we do full South at twelve o'clock; the whole of this diverſity is eaſily explained by viewing the *Circular Maps*, and obſerving this Phænomenon is ſolely occaſioned by the places being ſituated on different ſides of the Sun's path, which is called the *Ecliptic*.

Having explained the nature and uſe of *Longitude* and *Latitude*, I have added the following Table, in which both the Longitude and Latitude of ſeveral principal places are accurately laid down.

A TABLE *of the* LATITUDES *and* LONGITUDES, *beginning the Longitude from the Meridian of* LONDON, *and their Bearings and Diſtance from the ſaid Place.*

Places Names.	Latitude D. M.	Longitude D. M.	Bearings.	Leagues Diſtance
Surrat	20 56 N	73 5 E	E.S.E.	1308
Canton, China	23 20 N	113 5 E	E.S.E.½E.	2130
Pekin	39 55 N	117 00 E	E.b.S.¼E.	1637
Madagaſcar S. end	26 7 S	46 20 E	S.S.E ½E.	1753
——— N. end	12 3 S	51 45 E	S.E.b.S.¼E.	1562
Manilla	13 55 N	117 6 E	E.S E.	2047
Japan, S.E. part	35 30 N	135 30 E	E.b.S.¼E.	1973
S. end of Sumatra	5 42 S	104 19 E	S.E.b E.¼E.	2060
St. Vincent	16 48 N	25 29 W	S.W.b.S.¼W.	827
St. Jago	15 8 N	23 16 W	S.S.W.	848
Medeira, W. end	32 20 N	17 30 W	S.W.b.S.	480
Ferro	28 00 N	18 5 W	S.S.W.½W.	596
Hacluit's Headland	79 55 N	11 00 E	N.¾E.	585
Black Point, S. end	78 00 N	10 30 E	N.¾E.	545
Dear Sound	79 15 N	12 40 E	N.½E.	549
Cherry Iſland	74 50 N	18 8 E	N.N.E.¾E.	507
Ice Point	77 40 N	69 10 E	N.E.	707
Archangel	64 30 N	40 30 E	N.E.b E.¼E.	480
North Cape	71 25 N	23 2 E	N.E.¼E.	435
North Point	62 20 N	5 26 E	N N.E.	230
Stockholm	59 20 N	18 15 E	N.E.b.E.½E.	240
Peterſburgh	60 30 N	30 20 E	E.N.E.¼E.	370
Dantzick	54 4 N	19 2 E	E.N E.½E.	222
Copenhagen	56 13 N	12 50 E	N.E b.E.	155
Hambrough	53 41 N	10 35 E	N.E.b.E.¾E.	115
Amſterdam	52 23 N	5 10 E	N.E b.E.¾E.	60
Antwerp	51 10 N	4 20 E	E.¾S.	51
Dunkirk	51 1 N	2 27 E	E b.S.	48
Calais	50 57 N	1 50 E	E.S.E.	30
St. Maloes	48 38 N	2 5 W	S.W.b.W.	76
Breſt	48 23 N	4 25 W	W.S.W.	85
Bourdeaux City	44 55 N	0 25 W	S.¼W.	130
Liſbon City	38 43 N	9 2 W	S.S.W.½W.	291
Cadiz	36 18 N	6 29 W	S.b.W.	325
Gibraltar	36 10 N	5 20 W	S.b.W.½W.	337
Genoa	44 27 N	9 50 E	S.E.¾E.	200
Rome	41 54 N	12 57 E	S E b.E.	265
Cape St. Maria	39 55 N	19 30 E	E.S.E.	332
Venice	45 40 N	12 50 E	E.S.E.	209
Conſtantinople	41 7 N	29 00 E	E.S·E.¾E.	467
Cape de Verde	14 47 N	17 12 W	S.¾W.	830
New Callabar	4 22 N	9 37 E	S.¾E.	926
Iſland of St Helena	15 54 N	4 10 W	S.¼W.	1370
Cape Bona Eſperance, or Cape of Good Hope	34 17 S	16 35 E	S.b.E.	1750
Iſland St. Katharines	28 00 S	50 10 W	S.S. W.	1760

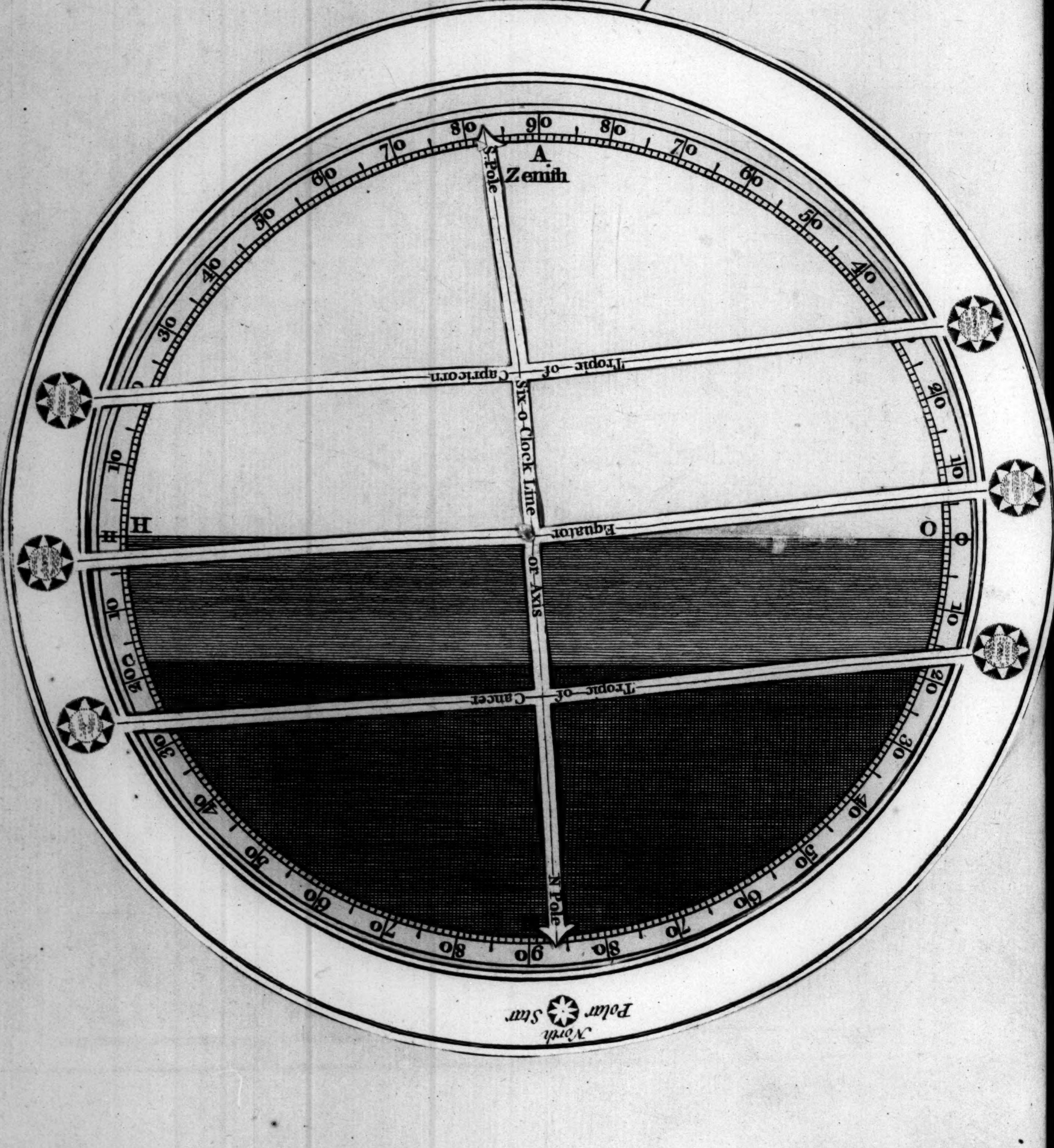
Places Names.	Latitude D. M.	Longitude D. M.	Bearings.	Leagues Diſtance
Cape Virgin Mary of Magellan's Straits	52 3 S	75 6 W	S.W.b.S.¼W.	2410
Cape Horn, the S. part of the Iſland Terra del Fuego	57 29 S	79 56 W	S.W.b.S.	2505
Iſland St. Maria de Agoſta	18 42 S	28 12 W	S.S.W.¼W.	1430
Placentia Bay	47 54 N	53 35 W	W.b.S.¼W.	635
Quebeck	47 5 N	68 15 W	W.b.S.	670
Cape Breton	46 9 N	58 30 W	W.b.S.½W.	695
Boſton Entrance	42 28 N	69 27 W	W.S.W.	740
New York	40 46 N	73 47 W	W.b.S¾W.	1000
Charles Town upon Aſhley River	32 41 N	78 47 W	S.W.b.W¾W.	1194
Cape Florida	24 48 N	81 54 W	S.W.b.W½W.	1340
River Spiritus Sanctus, or Miſſiſippi River's Mouth	28 52 N	96 50 W	W.S.W.	1495
Campeachy	19 21 N	92 44 W	S.W.b.W.¼W.	1553
Cape Honduras	16 24 N	87 52 W	S.W.b.W.¾W.	1533
Porto Bello	9 56 N	80 17 W	S.W.b W.	1545
Carthagena	10 33 N	75 26 W	S.W.¾W.	1465
Surinam	6 15 N	56. 50 W	S.W.½W.	1293
Mouth of the River Amazons	0 00	49 56 W	S.W.b.S.¾W.	1395
Tobago, W. end	11 12 N	59 12 W	S.W.b.W.	1233
Bridge-Town Barbadoes	12 56 N	58 40 W	S.W.½W.	1210
St. Vincent	13 17 N	60 13 W	S.W.½W.	1250
Montſerrat	16 58 N	60 56 W	S.W.¾W.	1198
St. Chriſtophers, or St. Kitts	17 26 N	61 59 W	S.W.¾W.	1190
Eaſt End of Hiſpaniola	18 20 N	69 16 W	S.W.b.W.¾W.	1240
Port Royal, Jamaica	17 41 N	76 34 W	W.S.W.	1393
Havannah, Iſland Cuba	22 43 N	82 56 W	W.S.W.¾W.	1410
Yarmouth	52 45 N	1 38 W	N.E.½E.	59
London	51 32 N	0 00		
Portſmouth	50 48 N	1 00 W	S.W.½W.	24
Edinburgh	57 55 N	2 55 W	N.b.W.	91
Dublin	53 12 N	6 55 W	N.W.b.W.½W	103
Acapulco, in Mexico	17 32 N	106 22 W	W.S.W.	1670
Agra, the Mogul's Court	28 34 N	83 20 E	E.S.E.	1325
Paris, France	48 53 N	2 22 E	S.E.¾E.	70
Brunſwick, Hanover	52 30 N	5 45 E	N.E.b E.½E.	117
Madrid, Spain	40 12 N	3 21 W	S.b.W.½W.	225
Moſcow, Ruſſia	55 36 N	38 50 E	N.E.b.E.½E.	490
Prague, Bohemia	50 42 N	14 36 E	E. Southerly	190
Iſpahan, Perſia	36 15 N	65 5 E	S.E.b.E.¾E.	945
Vienna, Germany	48 22 N	17 20 E	E.N.E.	230



EUROPE,
Drawn from the best
Authorities;
Regulated by
Astron.l Observat.ns
By Tho.s Kitchin Geog.r

To face the Description and use of it

The Planisphere



SECTION IX

Deſcription and Uſe of the PLANISPHERE, *and Semicircle of* HOURS.

THIS Planiſphere conſiſts of two parts, one immoveable the other moveable. On the firſt and immoveable part is deſcribed the Meridian divided into degrees, and thus from O to the Zenith is divided into 90 degrees, ſo that the Quadrant O A repreſents North Latitude; and the Quadrant H A, is is alſo divided into 90 degrees, which repreſents South Latitude; and the lower, or right part of the Meridian being divided alſo in the ſame manner, is deſigned to ſhew the Sun's * Amplitude when on the Tropicks.

The line H O, is the Horizon, which from the center to O is called the North Horizon, and from the center to H, is the South Horizon.

The diſtance from H to C, and O to D, is the Twilight, and that part under the line C D is Night.

The Zenith and Nadir are two points diametrically oppoſite to each other, as is repreſented by N the Nadir, and the point A oppoſite the Zenith.

The ſecond, or moveable part, conſiſts of the Axis, or 6 o'clock line, the North and South Poles marked S. P. for South Pole, and N. P. for North Pole; the northern Tropick, or Tropick of Cancer; the ſouthern Tropick, or Tropick of Capricorn, and the Equator.

On the outer part, in a circle, is the Sun on the Tropicks and Equator, which will help to form an idea of the difference of heat and cold in the ſeveral parts of the Earth.

The ſemicircle of hours is divided,—the ſtrait ſide into 12 hours; the arch into 180 degrees 00 minutes, and every 15 degrees 00 minutes making an hour of time, is drawn into hours, half hours, and quarters. Having thus given a deſcription of the Planiſphere and Semicircle, I ſhall next proceed to ſhew their uſe.

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* Amplitude is that part of the Horizon, either Eaſt or Weſt, on which the Sun or Star riſes or ſets.

EXAMPLE I.

Required the time of the Sun riſing and ſetting, and the length of the longeſt and ſhorteſt days and nights, (when the Sun is on the Tropicks) at *Copenhagen* in *Denmark?*

OPERATION I.

Look in the Table of Latitude and Longitude, *&c.* for the Latitude of *Copenhagen*, which you will find to be 56 degrees 13 minutes North, then elevate the * *North Pole* to little more than 56 degrees on the Meridian, and there ſtay it; then take the Semicircle and lay it on the Tropick of Cancer †, the Figure VI, right on the 6 o'clock line; the Figures I, II, *&c.* below the Horizon, and the Horizon will cut the Semicircle at 20 minutes after 3, the time of the Sun riſing; then, by turning the Semicircle upſide down on the ſaid Tropick, the Horizon will cut the Semicircle at 40 minutes after 8, the time of Sun ſetting. Now the time of Sun ſetting being doubled, (*i. e.* twice 8 hours and 40 minutes) is 17 hours 20 minutes, the length of the longeſt day at *Copenhagen*; the hours on the Semicircle, below the Horizon, being 3 hours 20 minutes, which doubled, is 6 hours 40 minutes, the length of the ſhorteſt night, though they have no night but Twilight at that time. You may obſerve that the ſhorteſt night, when the Sun is on the Tropick of *Cancer*, is juſt the length of the day when the Sun is on the Tropick of *Capricorn*; and the longeſt day, when the Sun is on the Tropick of *Cancer*, is juſt the length of the longeſt night, when he is on the Tropick of *Capricorn*. As thus, the ſhorteſt day is 6 hours 40 minutes, and longeſt night 17 hours 20 minutes, (making in all 24 hours) the Sun riſeth on the ſhorteſt day there at 40 minutes after 8 o'clock, and ſetteth at 20 minutes after 3 o'clock.

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* Be careful when it is *North* Latitude, to elevate the *North Pole*, and when *South* Latitude, elevate the *South Pole*. The North Latitude runs from O upwards to A.

† In this firſt poſition of the Semicircle, you muſt lay it ſo as the writing and figures thereon are reverſed.

EXAMPLE II.

Required the time of the Sun riſing and ſetting at *Cape Horn*, and length of the day and night there when he is on the Tropick of [*] *Cancer*, it being then Summer at *London*, but Winter at *Cape Horn*?

OPERATION II.

Look in the table of Latitude and Longitude for *Cape Horn*, and you will find it is in Latitude 57 degrees 30 minutes South; then elevate the *South Pole* to the Latitude on the Meridian, and apply the Semicircle as before directed, to the Tropick of *Capricorn*, and you will have the Horizon cut it at 45 minutes after 8, the time of Sun riſing; and by turning the Semicircle, you will have the Horizon cut it at 15 minutes after 3, the time of the Sun ſetting. Now the Sun ſetting doubled, is the length of the day, *viz.* 6 hours 30 minutes, and the Sun riſing doubled, is the length of the night 17 hours 30 minutes.

EXAMPLE III.

Required the length of the days and nights, when the Sun is on the Tropicks, at *Canton* in *China*; alſo the time of the Sun riſing and ſetting, and length of the Twilights at thoſe times?

OPERATION III.

Look in the tables of Latitude, *&c.* for *Canton*, and you will find it is in Latitude 23 degrees 20 minutes North; then elevate the *North Pole* to the Latitude on the Meridian, and apply the Semicircle as directed in the firſt Example to the Tropick of *Cancer*, and you will find the Horizon to cut it at 20 minutes after 5, the time of Sun riſing, when on the ſaid Tropick, and by turning the Semicircle, the Horizon will cut at 40 minutes after 6, the time of Sun ſetting; then apply the Semicircle on the Tropick of [*] *Capricorn*, as directed to find the Sun's riſing, by the 1ſt Example, and the Horizon will cut it at 40 minutes after 6, the time of Sun riſing, and by turning the Semicircle, for Sun ſetting, the Horizon will cut it at 20 minutes after 5, the time of Sun's ſetting; thus the longeſt day is 13 hours 20 minutes, and the ſhorteſt night 10 hours 40 minutes; and the ſhorteſt day 10 hours 40 minutes, and the longeſt night 13 hours 20 minutes; and for the Twilight count what time is on the Semicircle from Sun ſetting to the dark part, or night, and you will find it to be 1 hour 40 minutes; the north Polar Star, which in *England* is ſeen very high in the Heavens, *i. e.* at the height of 51 degrees 30 minutes, but in *China* it is much nearer the Horizon, being only elevated there 23 degrees, which is evident from a bare inſpection of the *North Pole* in the *Planiſphere*.

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[*] The Sun is on the Tropick of *Cancer* the 21ſt of *June*, which makes the *longeſt day* to the inhabitants of *London*, and to all thoſe that are ſituated in North Latitude. The Sun is on the Tropick of *Capricorn* the 21ſt of *December*, which makes the *ſhorteſt day* to thoſe who are ſituated in *London* or North Latitude; but the inhabitants of *New Zealand*, which is South Latitude, have their longeſt day at our ſhorteſt, and their ſhorteſt at our longeſt.

EXAMPLE IV.

Required, the time of Sun riſing and ſetting, and the lengths of the days, nights, and twilight at *London*, when the Sun is on the Tropicks?

OPERATION IV.

Look in the tables of Latitude, *&c.* for *London*, which is in Latitude 51 degrees 30 minutes North. Then elevate the *North Pole* to the Latitude on the Meridian, and apply the Semicircle as directed in the firſt Example on the Tropick of *Cancer*, and the Horizon will cut it at 50 minutes after 3, which is the time of the Sun riſing, and then turn the Semicircle and the Horizon will cut it at 10 minutes after 8, the time of Sun ſetting; and the length of the day is 16 hours 20 minutes, and the night 7 hours 40 minutes, and the twilight is 3 hours 50 minutes; and when the Sun is on the Tropick of *Capricorn*, the twilight is only 2 hours 0 minutes, the Sun riſeth at 10 minutes after 8, and ſetteth at 50 miuutes after 3, when on this Tropick, ſo that the ſhorteſt day is 7 hours 40 minutes, and the longeſt night is 16 hours 20 minutes.

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[*] In all NORTH Latitudes you muſt apply the Semicircle to the *Tropick of Capricorn*, for ſhorteſt days, and the *Tropick of Cancer* for the longeſt days.

EXAMPLE

EXAMPLE V.

Required, the time of Sun riſing and ſetting, with the length of the days, nights, and twilight at *Port Royal* in *Jamaica*, when the Sun is on the Tropicks?

OPERATION V.

The Latitude of *Port Royal* in *Jamaica*, is about 18 degrees North; therefore elevate the *North Pole* to 18 degrees, apply the Semicircle on the Tropick of *Cancer*, and the Horizon will cut it at half paſt 5, the time of the Sun's riſing. Reverſe the Semicircle and it will cut the Horizon at half paſt 6, the time of Sun ſetting—the hour of Sun ſetting (*i. e.* 30 minutes paſt 6) being doubled, gives their longeſt day at *Jamaica*, which is 13 hours; for their ſhorteſt day, apply the Semicircle to the Tropick of *Capricorn*, and the Horizon will cut it at half paſt 6; for Sun riſe turn the Semicircle upſide down, and the Sun will cut it at half paſt 5, the time of Sun ſetting, which being doubled gives 11 hours, and is the length of their ſhorteſt day.—*N. B.* All places in ſmall Latitudes that is near the Equator, have but little variation in their days and nights; but it is very different in higher Latitudes that is further from the Equator, as is ſhewn in the following Example.

EXAMPLE VI.

Required, the time of the Sun riſing and ſetting at *Lapland* in *Sweden*, with the length of their days and nights, twilight, *&c.* when the Sun is on the Tropicks?

OPERATION VI.

The Latitude of *Lapland* being about 65 degrees North, elevate the *North Pole* to that Latitude on the Meridian, the Horizon will cut the Semicircle a little before 2, the time of Sun's riſing; reverſe the Semicircle and the time of Sun's ſetting will be a little after 10, which will make their longeſt day more than 20 hours; for their ſhorteſt day lay the Semicircle upon the Tropick of *Capricorn*, it will ſhew the Sun to riſe at half paſt 10; reverſe the Semicircle you will ſee the Sun to ſet about half paſt 1 o'clock, making their ſhorteſt day only three hours. In thoſe high North Latitudes, on their longeſt day they have but little, if any twilight, the Sun ſcarcely declines at that time ſufficiently below the Horizon as to occaſion a light feint enough to be termed twilight, for even their mid-night in thoſe regions in Summer, is nearly as bright as ſome of our Winter days. But in their ſhorteſt days they have conſiderable twilight, which is eaſily ſeen by counting what time it is on the Semicircle from Sun ſetting to the dark part or night, and you will find it to be 2 hours.

Thoſe examples and directions for the uſe of the *Planiſphere*, &c. already given, may be ſufficient to teach any one the uſe, ſo that it will be only neceſſary to add ſome few queſtions for practice without the Operation.

EXAMPLE VII.

Required, the time of the Sun riſing and ſetting, with the length of the days, nights, and twilight at *Rome*, when the Sun is on the Tropicks? The Latitude of *Rome* is 42 degrees North.

EXAMPLE VIII.

Required, the time of the riſing and ſetting of the Sun, *June* the 21ſt, and *December* the 21ſt, *September* the 23d, and *March* the 21ſt, with the length of the days, nights, and twilight, at the Iſland of *St. Helena*, in Latitude 16 degrees *South*?

EXAMPLE IX.

Required, the time of Sun riſing and ſetting, and length of the days, nights, and twilights, on *December* the 21ſt, *March* the 21ſt, *June* the 21ſt, and *September* the 23d, at *Leghorn*, in Latitude 43 degrees North?

EXAMPLE X.

Required, the time of Sun riſing and ſetting, and length of the day and night, on the 21ſt of *June*, at the *Havannah*, in Latitude 23 degrees North?

EXAMPLE XI.

Required, the time of Sun riſing and ſetting, with the length of the day, night, and twilight, on the 21ſt of *December*, at the *Cape of Good Hope*, in Latitude 34 degrees South ?

EXAMPLE XII.

Required, the time of Sun riſing and ſetting, with the length of the days, nights, and twilight, on the 21ſt of *June*, at the Iſland of *St. Catherines*, on the coaſt of *Brazil*, Latitude 27 degrees South ?

EXAMPLE XIII.

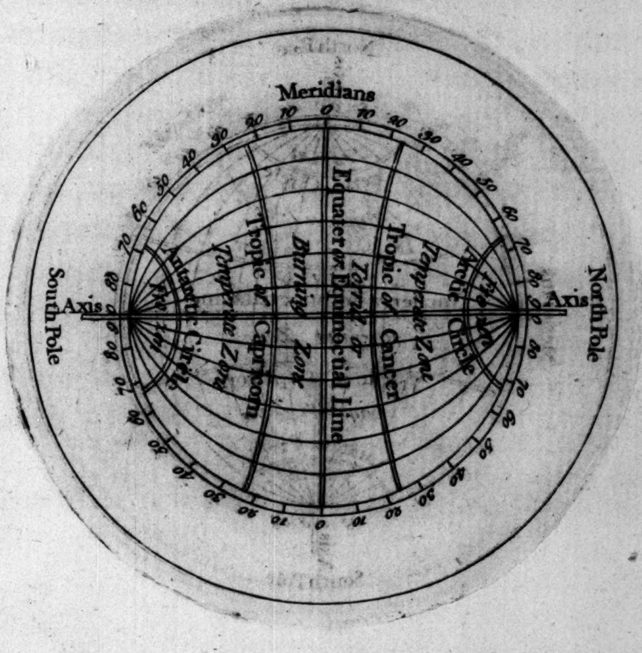
Required, the time of Sun riſing and ſetting, and length of day, night, and twilight, on the 21ſt of *December*, at the coaſt of *Guinea*, in *Africa*, whoſe Latitude is about 5 degrees North ?

EXAMPLE XIV.

Required, the time of Sun riſing and ſetting, and length of the day and night, on the 21ſt of *December*, at *Stockholm* in *Sweden*, Latitude 59 degrees North ?

EXAMPLE XV.

Required, to form a RIGHT SPHERE, OF TORRID ZONE ?

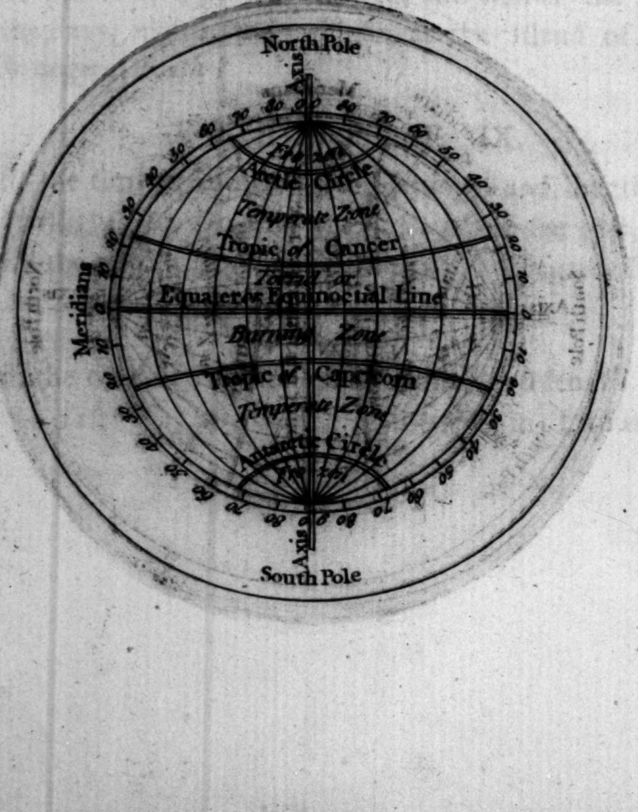


OPERATION XV.

Bring the Poles in the Horizon, and then the Equator will make right angles with the Horizon, and therefore is called a right ſphere. The inhabitants whoſe ſphere is in this poſition have their days and nights of equal length at all times of the year, and conſequently live under the Equinoctial, or on the Equator, and as the Sun ſhines perpendicular, have very hot weather all the year round; and all places that are ſituated between the Tropicks have a great heat from the Sun. The *North Pole*, a Star ſo called, is always ſeen nearly over our heads, but here it is ſeen juſt even with their Horizon, and never riſes any higher. The inhabitants of this ſphere are ſaid to live under the Line, as they do in many places of *Africa*, *Eaſt Indies*, and *America*; all the Stars in both Hemiſpheres are viſible to them in different parts of the year. Thoſe who inhabit this TORRID ZONE have the Sun perpendicular over their heads two days in the year, in paſſing from Tropick to Tropick, they being ſituated between the Tropicks.

EXAMPLE XVI.

Required, to form a PARALLEL SPHERE, being the *Polar Region* or FRIGID ZONE?



OPERATION XVI.

Bring the Poles to the Zenith and Nadir, and then the Equator will be in the Horizon, and the Tropicks parallel thereto, and therefore is called a *Parallel-ſphere.* The inhabitants, if any ſo miſerable, whoſe ſphere is in this poſition, have one half the year day, and the other half the year night and twilight; and as the Sun's rays fall with a great obliquity on them, they muſt have exceſſive cold weather all the year, though warmer at one time than the other. Their ſhadows move all round them; in their Winter they ſee the Stars as conſpicuous at noon-day as at mid-night. They have alſo a twilight here that continues for two months, and never ſee but half of the Heavens, which is continually revolving round them.

EXAMPLE XVII.

Required, to form an OBLIQUE SPHERE, being our own ſituation on * the TEMPERATE ZONE.

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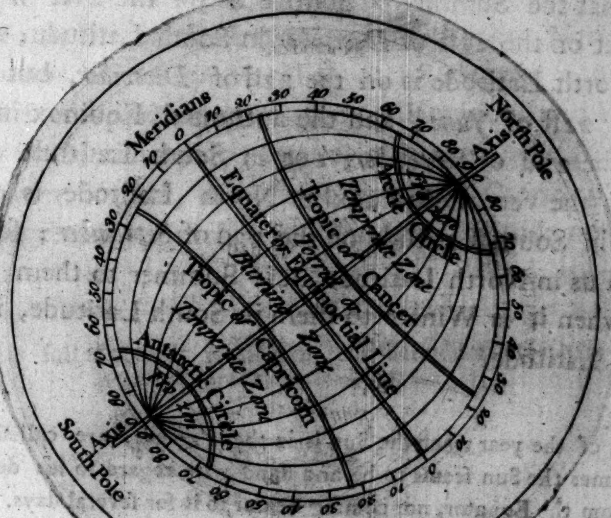
* There are two *Temperate Zones*—we inhabit the North Temperate Zone, and find the ſeaſons of the year in a temperate degree. Our Summer's Sun is at a diſtance from our Zenith, and we do not therefore experience the greateſt force of his beams;—Again, we are never without his enlivening influence the ſpace of one natural day, ſo that upon the whole we muſt reckon our ſituation the beſt that the ſurface of the Earth can afford, the agreeable ſituation of *England* being the moſt temperate part of the *Temperate Zone.*



OPERATION XVII.

Elevate either the North or South Pole 30 degrees 0 minutes, on the Meridian, ſo have you an *oblique ſphere*, as the Equator makes an oblique angle with either the North or the South Horizon, (an oblique angle being more than 90 degrees 0 minutes, a right angle 90 degrees 0 minutes, an acute angle leſs than 90 degrees 0 minutes). If the *North Pole* is elevated, then the Equator makes an oblique angle with the North Horizon; if the South Pole, the contrary. In this poſition of the ſphere we have the day and night of equal length twice a year, which are the times the Sun is on the vernal and autumnal Equinoxes; and ſince the Sun each day deſcribes by his apparent diurnal motion, ſome parallel from the time of the vernal Equinox, to the Summer Solſtice, the days grow longer and longer, and will be continually longer than the nights; after the Summer Solſtice, though the days continue to the autumnal Equinox to be longer than the nights, yet they become ſhorter and ſhorter, and at the Equinox they but juſt equal the nights. From thence to the Winter Solſtice, the days continually become ſhorter than the nights, and are the ſhorteſt when the Sun is in that Solſtice, but as the Sun leaves it they increaſe again, and in the vernal Equinox the day is as long as the night.

N. B. That the Summer [*] Solſtice is on the 21ſt of *June* in North Latitude, but on the 21ſt of *December* in South Latitude; and the Winter Solſtice in North Latitude is on the 22d of *December*, but in South Latitude on the 21ſt of *June*; and the autumnal Equinox in North Latitude is on the 23d of *September*, but in South Latitude on the 21ſt of *March*; and the vernal Equinox in North Latitude is on the 21ſt of *March*, but in South Latitude on the 23d of *September*; ſo that when it is Winter to us in North Latitude, it is Summer to them in South Latitude; and when it is Winter to them in South Latitude, it is Summer to us in North Latitude.

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[*] The ſeaſon of the year when the Sun is in the *Tropicks*, are called the *Solſtices*, becauſe at thoſe times the Sun ſeems to be at a ſtand with regard to his declination, neither going further from the Equator, nor coming nearer to it for ſeveral days.

EXAMPLE

EXAMPLE XVIII.

To find the Sun's Meridian Altitude or Height at 12 o'Clock at Noon.

Required, the Sun's * Meridian Altitude, or height above the Horizon, when on the Meridian (or 12 o'clock) on the 21ſt of *June*, 23d of *September*, 21ſt of *March*, and 21ſt of *December*, at *London?*

OPERATION XVIII.

Elevate the North Pole to the Latitude of *London*, as *per* Table, and you will find the Tropick of *Cancer* to cut the Meridian at 62 degrees 0 minutes, the Meridian Altitude for the 21ſt of *June*; and the Equator to cut the Meridian at 38 degrees 0 minutes, the Meridian Altitude on the 23d of *September*, and 21ſt of *March*; and the Tropick of *Capricorn* to cut the Meridian at 15 degrees 0 minutes, the Meridian Altitude on the 21ſt of *December*.

EXAMPLE XIX.

Required, the Sun's Meridian Altitude, or the Sun's height at noon, on the 21ſt of *June* and 21ſt of *December*, 23d of *September* and 21ſt of *March*, at *Rome*, whoſe Latitude is 42 degrees North?

OPERATION XIX.

Elevate the North Pole to the Latitude of 42 degrees North, and you will find the Equator to cut the Meridian at 48 degrees 0 minutes, the Meridian Altitude on the vernal and autumnal Equinox; and the Tropick of *Cancer* to cut the Meridian at 73 degrees 0 minutes, the Meridian Altitude on the Summer Solſtice, and the Tropick of *Capricorn* to cut the Meridian at 25 degrees 0 minutes, the Meridian Altitude on the Winter Solſtice.

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* **When the Sun is full South, it is then on our Meridian, which is always about 12 o'clock at noon.**

EXAMPLE XX.

Required, the Sun's Meridian Altitude on the Summer and Winter [*] Solſtice, and on the vernal and autumnal Equinoxes, [†] at *Athens*, which is in 38 degrees North Latitude?

OPERATION XX.

Elevate the North Pole to the Latitude, and you will find the Equator to cut the Meridian at 52 degrees 0 minutes, the Meridian altitude on the vernal and autumnal Equinoxes, and the Tropick of *Cancer* to cut the Meridian at 76 degrees 0 minutes, the Meridian Altitude on the Summer Solſtice; and the Tropick of *Capricorn* to cut the Meridian at 30 degrees 0 minutes, the Meridian altitude on the Winter Solſtice.

EXAMPLE XXI.

Required, the Sun's Meridian Altitude on the 21ſt of *December*, 21ſt of *June*, 23d of *September*, and 21ſt of *March*, at *Cape Horn*, which is in 57 degrees South Latitude?

OPERATION XXI.

Elevate the South Pole to the Latitude, and you will have the Equator cut the Meridian at 33 degrees 0 minutes, the Meridian Altitude on the Vernal Equinox the 23d of *September*, and Autumnal Equinox on the 21ſt of *March*; and the Tropick of *Capricorn* cut the Meridian at 59 degrees 0 minutes, which is the Meridian Altitude, on the 21ſt of *December*, the Summer Solſtice; and the Tropick of *Cancer* to cut the Meridian at 12 degrees 0 minutes, the Meridian Altitude, on the 21ſt of *June*, the Winter Solſtice.

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[*] There are two *Solſtices* in each year; one in the Summer and the other in the Winter. The Summer *Solſtice* is on *June* the 21ſt; the Sun is then in *Cancer*, which makes our longeſt day. The Winter *Solſtice* is when the Sun enters the firſt degree of *Capricorn*, which is on *December* the 22d, when he makes the ſhorteſt day.

[†] The vernal Equinox is when the Sun enters into the ſign *Aries*, this is 20th of *March*. The autumnal Equinox is when the Sun enters *Libra*, that is 23d *September* as before ſhewn.

EXAMPLE XXII.

Required, the Sun's Meridian Altitude, on the Summer and Winter Solſtice, and on the Vernal and Autumnal Equinoxes, at *Gibraltar*, which is in 36 degrees North Latitude?

OPERATION XXII.

Elevate the North Pole to the Latitude, and the Equator will cut the Meridian at 54 degrees 0 minutes, the Meridian Altitude on the Vernal and Autumnal Equinoxes; and the Tropick of *Cancer* cut the Meridian at 78 degrees 0 minutes, the Sun's Meridian Altitude on the Summer Solſtice; and the Tropick of *Capricorn* cut the Meridian at 34 degrees 0 minutes, the Meridian Altitude when on the Winter Solſtice?

EXAMPLE XXIII.

Required, the Sun's Meridian Height, when on the Tropick of *Cancer*, the 21ſt of *June*, at *Greenland*, whoſe Latitude is about 75 degrees North? Alſo the Sun's Meridian Height at that place when in the Equator, on the 21ſt of *March* and 23d of *September?* Alſo the Sun's Meridian Height, when in the Tropick of *Capricorn*, on the 23d of *December?*

OPERATION XXIII.

Elevate the North Pole to 75 degrees North Latitude, then will the Tropick of *Cancer* cut the Meridian at 40 degrees, and ſhews the Sun never riſeth higher than 40 degrees above the Horizon to the *Greenlanders*, ſo that they never ſee the Sun near ſo high above the earth as we do. In *March* and *September* with them the Sun but juſt appears above their Horizon; and in *November*, *December*, and *January*, they ſee no Sun at all during thoſe three months, The Sun, as is ſeen by the *Tropick of Capricorn*, is continually below their Horizon, affording them only a little twilight.

EXAMPLE XXIV.

Required, the Sun's utmoſt height at the North Pole, Latitude 90 degrees, when in the Tropick of *Cancer*, the Equator, and the Tropick of *Capricorn*, that is, in *June*, *September*, *March*, and *December*.

OPERATION. XXIV.

Elevate the North Pole to 90 degrees, then you will ſee the Sun when in the Tropick of *Cancer*, *i. e.* on the 21ſt of *June*, is only with them 24 degrees above the Earth or Horizon, ſo that the Inhabitants of this uncheary clime (ſhould there be any) can never ſee the Sun higher in their Heaven, on their brighteſt Summer day, than we ſee it about the 31ſt of *December:* but when the Sun is in the Equator on the 21ſt of *March* and 23d of *September*, thoſe two days the Sun never riſeth to them, but is ſeen, for both theſe days, one-half of his orb above, and one-half below the Horizon. Should it be the 21ſt of *September*, the next day, *i. e.* the 22d, the body of the Sun will totally diſappear, and they will not again, for half a year, be bleſt with this uſeful light; but on the 23d of *September* that glorious Luminary will again appear to, and be that whole day near the Horizon; but the next day will appear above their Horizon, and continue perpetually ſhining night and day till the 21ſt of *March*, and then begins to touch the Horizon, and preſently after diſappear for a long night of ſix months. All this will be clearly ſeen by inſpecting the *Planiſphere*, when the North Pole is ſet to the Latitude which is 90 degrees North (where the A Zenith is wrote); then obſerve the Suns in the outward circle; the upper Sun, which is on the Tropick of *Cancer*, (which is the Sun's place the 21ſt of *June*) will be about 24 degrees above Horizon; the Sun in the Equator (which is the Sun's place the 21ſt of *March* and the 23d of *September*) will be juſt level with the Horizon or Earth, conſequently of but little uſe to the Polar Inhabitants: but when you obſerve the Sun on the Tropick of *Capricorn*, (which is his place the 21ſt of *December*) he is then totally under the Earth, affording neither light nor heat to the miſerable Inhabitants.

EXAMPLE XXV.

Required, the Sun's Meridian Altitude, on the Summer and Winter Solſtice, and on the Vernal and Autumnal Equinoxes, at Cape St. *Maria*, on the coaſt of *Brazil?*

OPE-

OPERATION XXV.

Elevate the South Pole to the Latitude, and the Equator will cut the Meridian at 55 degrees 30 minutes, the Sun's Meridian Altitude on the vernal Equinox, which in this Latitude is on the 23d of *September*, and the Autumnal Equinox, which is on the 21ſt of *March*; and the Tropick of *Cancer* will cut the Meridian at 32 degrees 0 minutes, the Sun's Meridian Altitude on the Winter Solſtice, the 21ſt of *June*; and the Tropick of *Capricorn* will cut the Meridian at 78 degrees, the Sun's Meridian Altitude on the Summer Solſtice, the 21ſt of *December*.

Here follows ſeveral examples to exerciſe the Reader, which may be anſwered without my giving any farther directions, having ſhewn the Operations of the others at large.

EXAMPLE XXVI.

Required, the Sun's Meridian Altitude on the 21ſt of *June*, at *Paris*, in 48 degrees North Latitude?

EXAMPLE XXVII.

Required, the Sun's Meridian Altitude, on the 21ſt of *December*, at *Madrid*, in 40 degrees 30 minutes North Latitude?

EXAMPLE XXVIII.

Required, the Sun's Meridian Altitude when on the Winter Solſtice, at *Liſbon*, in 38 degrees 45 minutes North Latitude?

EXAMPLE XXIX.

Required, the Sun's Meridian Altitude when on the Summer and Winter Solſtices, at *Madeira*, one of the *Canary Iſlands*, in 32 degrees 30 minutes North Latitude?

EXAMPLE XXX.

Required, the Sun's Meridian Altitude when on the Summer and Winter Solſtices, Vernal and Autumnal Equinoxes, at *Pekin* in *China*, in 40 degrees North Latitude?

EXAMPLE

EXAMPLE XXXI.

Required, the Sun's Meridian Altitude when on the Summer and Winter Solſtices, and Vernal and Autumnal Equinoxes, at Cape *Virgin Mary, Magellan's Straits ?*

To find the CLIMATES.

The Ancients uſed to reckon the Climates, of which there are 24. To know in what Climate is any propoſed place of the Earth, the Latitude of which is known, we need only, by the *Planiſphere*, to find the length of the longeſt Summer's day, and from that ſubſtract 12 hours; the remainder doubled gives the Climate. For example: At *Paris*, where the elevation of the Pole (or Latitude) is 49 degrees, the longeſt Summer's day is 16 hours, from which if you take 12, the remainder is 4, the double of which is 8, ſhews that *Paris* lies in the eighth Climate.

EXAMPLE.

Required, in what Climate *London* is ſituated ?

OPERATION.

Find by the Planiſphere the length of the longeſt day, which will be about 16 hours and an half, ſubſtract 12 therefrom, the remainder is 4 and an half, which doubled make 9; therefore London is in the 9th northward Climate.

These Examples already given are ſufficient to enable any perſon to uſe the Planiſphere with pleaſure.

SECTION

SECTION X.

Of the TWILIGHT.

IT has before been obſerved, that by the Atmoſphere we are favoured with the light of the Sun before he is above, and after he is below, our Horizon, and this is performed by what is called the Laws of Refraction, and is called *Twilight*;—therefore if we had no Atmoſphere, we ſhould have no Twilight, for the Atmoſphere is the principal cauſe, as ſhall be ſhewn hereafter; that were we deprived of this great bleſſing, we ſhould be convinced it would be attended with the following inconveniencies. *Firſt*, We ſhould be ſurrounded with darkneſs till the moment of Sun riſing. *Secondly*, It would break out in an inſtant from under the Horizon, ſhew itſelf as bright as it would appear towards the middle of Day, and would not in the leaſt change his appearance till the inſtant of his ſetting, when it would be equally obſcure and dark as the middle of the darkeſt night. Our eyes are not calculated to bear ſuch ſudden tranſitions—the great Author of Nature for this and other weighty reaſons, has cauſed an Atmoſphere.

The Sun, indeed, would ſtrike our eyes with a lively brightneſs, but it would only reſemble a clear fire which we ſhould ſee during the night in a ſpacious field. It would be day light, and we ſhould ſee the Sun and the adjacent objects round us, but the rays which fell on ſuch lands as are remote, would be loſt.

But ſince there is an Atmoſphere covering the Earth, and is illuminated by the Sun, it reflects the light back to us, and makes the Heavens to ſhine, and that ſo ſtrongly, that it renders the Stars inviſible.

By the means of the Atmoſphere it happens, that, though after Sun ſetting we receive no direct light from the Sun, yet we enjoy its reflected light for ſome time; ſo that the darkneſs of the night comes not ſuddenly, but by degrees.

For after the Earth, by its revolution round its Axis, hides the Sun from us, the Atmoſphere, which is higher than us, will ſtill be illuminated by the Sun, ſo that for a while the whole Heavens will have ſome of his light imparted to it; but as the Sun goes lower under the Horizon, the leſs is the Air illuſtrated by him; ſo that when he is 18 degrees below the horizon, he no longer enlightens our Atmoſphere, and then all that part that is over us becomes dark.

Likewiſe in the morning, as ſoon as the Sun comes within 18 degrees of the Horizon, he begins again to enlighten the Atmoſphere, and diffuſe his light through the Heavens; ſo that its brightneſs increaſes, till the Sun riſeth and makes full day.

This enlightening the Atmoſphere, and ſtate of the Heavens between day and night, is called Twilight, which is obſerved in the morning, before Sun riſing, and at night, after his ſetting.

In Winter the Air being condenſed by the cold, is low, and on that account the Twilights are ſooner over.

In the Summer the Air is rarefied by heat, and therefore, being higher, remains longer enlightened by the Sun, ſo that the Twilights laſt the longer, and the duration of the Twilight is ſhorter at morning than at night.

In a right poſition of the Sphere, the Twilights are quickly over, becauſe the Sun riſeth and ſetteth nearly in a perpendicular; but in an oblique Sphere they laſt longer, the Sun riſing and ſetting obliquely, and the greater the Latitude of the place, ſo much longer laſt the Twilights, ſo that all thoſe who are in 49 degrees of Latitude in the Summer, near the Solſtice, have their Atmoſphere enlightned the whole night, and the Twilight laſts till Sun riſing, without any compleat darkneſs, as may be demonſtrated by the *Planiſphere*.

In a Parallel Sphere the Twilights laſt for ſeveral months, ſo that the inhabitants of this poſition have either direct or reflex light of the Sun nearly all the year, as will plainly appear by uſing the *Planiſphere*.

There is a great difference between the increaſe of the Twilight and its decreaſe, and the increaſe and decreaſe of the days and nights, while the Sun moves from the beginning of *Cancer* to the firſt of *Capricorn*; all that time the days conſtantly decreaſe, and the nights increaſe; but in the Twilight it is otherwiſe; for though the Twilight and the days are at the longeſt when the Sun is in the firſt degree of *Cancer*, and then they both decreaſe together, yet the times of Twilight do not continually decreaſe till the Sun comes to *Capricorn*. But there is a certain point between *Libra* and *Capricorn*, to which, when the Sun arrives, we have the ſhorteſt Twilight, which happens on *October* the 12th, and *March* the 1ſt; and although the days from the beginning of the Sun's entry into *Capricorn*, do conſtantly increaſe, yet the Twilights grow ſhorter till the Sun, in his return to the Northern Tropick, comes to the ſhorteſt Twilight, which is demonſtrated by the *Planiſphere*.

SECTION XI.

The Properties of AIR.

THE Air is made up of three different kinds of Corpuſcles, *viz.* 1ſt. of thoſe numberleſs and minute particles, which in the form of vapours or dry exhalations, aſcend from the Earth, Waters, Minerals, Vegetables, Animals, &c. In ſhort, of whatever ſubſtances that are elevated by the celeſtial or ſubterraneous heat, and thence diffuſed into the Atmoſphere.—2d. Of a ſtill more ſubtile matter, conſiſting of thoſe exceedingly minute atoms, the Magnetical effluvia of the Earth, with other innumerable particles ſent from the bodies of the celeſtial luminaries, and cauſing by their impulſe the idea of Light in us.—3dly. Of an elaſtic ſubſtance, which is the baſis of all the other parts, and conſtituting the true eſſence of Air, concerning the ſtructure of which, various hypotheſes have been framed; ſome have reſembled theſe elaſtic particles to the ſpring of watches coiled up, and endeavouring to reſtore themſelves; others to flocks of wool, which being compreſſed, have an elaſtic force, and others to ſlender wires of different ſubſtances, conſiſtences, &c. yet all ſpringy expanſible and compreſſable; we have ſeveral curious experiments to prove this wonderful property of Air.—Tie up a little Air in a Bladder and put it under the receiver of an Air Pump, and when the external Air is pumped out, the internal Air in the Bladder will expand, and thus ſwell ſo as to fill it, and even thin ſquare phials well ſtopped will break to pieces when once the external Air is pumped away from them. Many more inſtances of this kind might be produced, which infallibly proves the elaſticity of the Air, 'Tis a curious and pleaſing experiment to *weigh the Air*, which is performed with an Air Pump, by exhauſting the Air from a Florence flaſk that has a valve fitted to prevent the external Air from ruſhing in. Firſt weigh the flaſk thus void of Air, then open the valve, the external Air will force in, then weigh again the flaſk, and it will be conſiderably heavier. Thus you will find a quart of Air in general weighs about ſeventeen grains, ſubject to ſome little variation, in proportion as the weather is more dull or bright. For the ſpring of the Air is ſometimes found to ſuſtain a pillar of Mercury thirty one inches high in the Barometer, when at other times it will only raiſe the Mercury to the height of twenty-eight inches. Taking therefore twenty-nine inches and a half for the general height of the Quickſilver, a column of it, whoſe baſe is one ſquare inch, weighs about fifteen pounds, which is the equal preſſure of Air upon every ſquare inch.

Hence, ſuppoſing the ſurface of a man's body to be 14½ ſquare feet, the Air ſuſtained by him will be 31,320 pounds, or nearly fourteen tons; a vaſt weight! was it not for *the wiſe diſpoſal* of things, this preſſure would be inſupportable to man; but Providence has ſo ordered, that the internal Air by its ſpring is an equipoiſe to the external preſſure, and we are not incommoded by it; but when the Air is lighteſt it will be only 13 tons, and when heavieſt 14 tons, the difference of which is one ton, equal to 2000 pounds, wherewith we are more compreſſed at one time than another.

This grand difference of preſſure muſt greatly affect our health. If a perſon be aſthmatical, he will find his diſorder increaſe with the levity of the Air. The reaſon why we think the Air is lighteſt in fine weather, when it really is the heavieſt, is becauſe the great preſſure conſtringes, or braces, the fibres and nerves; and thus aſſiſting their elaſticity, makes us more vigorous than ordinary; whereas, on the contrary, when this preſſure is leſſened by near 2500lb. the fibres are relaxed, and a gloomy, lifeleſs heavineſs enſues. The nerves require either preſſure or extention. Few laborious people are troubled with nervous complaints: their daily bread is acquired by that exerciſe which keeps their nerves and fibres in their requiſite extention, which affords them that health, and flow of animal ſpirits, that the luxurious indolent ſo much wiſh for, but are ever deprived of. Their inactivity will not inſpire the nervous ſyſtem to its proper tone. Thus we ſee the bounty and impartiality of Providence; thoſe that are compelled to ſimple diet and uſeful labour, are rewarded with firm and robuſt conſtitutions, whilſt the voluptuous and idle are enervated, and obliged to fly to medicines for that fallacious aſſiſtance which can only be found in exerciſe and temperance.

Air will alſo expand itſelf to an amazing degree. Take a very ſhrivelled Apple, and place it under the Receiver of an Air-pump: exhauſt the external Air, and the ſmall particles of Air contained in the ſhrivelled Apple will immediately expand themſelves, and ſwell out the Apple as plump and full as when in its bloom. By extracting the external Air from Fiſhes, the Air confined in their bladder will ſo much extend itſelf as even to burſt the bladder.[*]

Dr. *Halley* firſt found out and demonſtrated, that if the height of the Air be taken in arithmetical proportion, the rarety of the Air will be in geometrical proportion. For inſtance:

At the height of

7	miles from the ſurface of the Earth the Air is	4	times thinner than at the ſurface.
14		16	
21		64	
28		256	
35		1024	
70		1048576	

Hence it will be eaſy to calculate, that a cubic inch of common Air, at the height of 500 miles, would be ſo much rarefied, that it would be as large as the orbit of Saturn; and therefore the Planets may move thro' the upper regions of the Heavens for many thouſand years without ſuffering any ſenſible reſiſtance.

Air, in ſome caſes, though very rarely, is ſubject to the light, or may be perceived by the eye. Thus, when you are placed upon an eminence, or riſing ground, in ſome open parts of the Country, in a ſituation nearly facing the Sun, on a hot Summer's day, then if there be gentle wind, or motion of the Air, it will be ſhewn by reflection of light from the body of Air in the vale below, and you will as perfectly ſee the undulations of waves of Air almoſt as you may thoſe of Water agitated by a gentle wind.

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[*] Place a globe of Water with Fiſh therein under the Receiver of an Air-pump; then extract the Air out of the Water, and the Fiſh will not be able to keep at the bottom of the Water, but will float upon the top: their bladders will be ſo much extended, having no external Air to reſiſt, that they muſt be forced to the top of the Water till their bladders burſt, and then they ſink to riſe no more.

SECTION XII.

Of the MONSOONS, *or* TRADE-WINDS.

THERE is ſomething wonderful in the phænomena of the Trade-Winds; I mean ſuch as always blow from one and the ſame quarter of the Globe. They are repreſented in the Maps by ſhades in and about the Torrid Zone, and their direction is conſtantly the way the little arrows ſeem directed. In the *Ethiopic*, *Atlantic*, and *Pacific Oceans*, (to 30 degrees from the *Equinoctial Line)* they are continually found to blow towards the Weſt; but in the Bay of *Bengal*, *Arabian*, *Chineſe*, and *Indian* Seas, the Winds vary, blowing one half of the year one way, and the other the contrary; *i. e.* in the Summer they blow to the N. E. but in the Winter to the S. W. Theſe are called the periodical Trade-winds, and by the Sailors Monſoons. As the arrows point their courſe on the Globes, ſo the times of ſhifting are denoted by the months thereto annexed. All ſhips which trade in theſe parts are obliged to obſerve the wonted Seaſons; by that means they never fail of a fair Wind to waft them to the wiſhed-for port, and another to return them to the haven where they would be.

Theſe Monſoons are occaſioned by the powerful influence of the Sun in thoſe warm Climates; for when the Air is very much heated, it will aſcend towards the upper part of the Atmoſphere, and the adjacent Air will ruſh in to ſupply its place, and therefore there will a ſtream or current of Air from all parts towards the place where the heat is. Hence we can eaſily account for the Monſoons or Trade-Winds, which about the Equator conſtantly blows from Eaſt to Weſt; for when the Sun ſhines perpendicularly on every part of the Earth, it will heat the Air in that part very much, which will therefore riſe upward, and the adjacent Air will ruſh in to fill up the vacuum, and conſequently cauſe a ſtream or current of Air from all parts towards the Sun: but as the Sun, with reſpect to the Earth, moves from Eaſt to Weſt, the common courſe of the Air will be that way too, continually preſſing after the Sun; and therefore at the Equator, where the Sun ſhines ſtrongly, there will be continual eaſterly Wind *; but on the North ſide it will incline a little to the North, and on the South ſide to the South.

Wind may be produced artificially, by filling a phial bottle with water, and a ſmall quantity of aqua fortis to make it acid; then a piece of chalk being put into the mixture, a fermentation will enſue, by which the particles of chalk will be ſeperated and turned into Air; and if a bladder was tied to the mouth of the bottle, it would not only be filled with this Air, but would burſt by the force of its ſpring. This may ſerve as a proof that the particles of bodies are converted into the common Air; that we breathe and exiſt by the very effluvia of that Earth from which we came. The lowneſs of the materials exalts our ideas of the *divine ſkill*; and when we think that duſt we are, and into duſt we ſhall return, we are put in mind of another ſcene, and that pride was not intended for man. If we are too much elated, we may recover our reaſon by looking at the Earth from whence we were digged, and ſtill claims us.

We ſhall now proceed to a view of the *heavenly Bodies*, and finiſh this part with a quotation from that learned elegant Author Dr. *Turner*. "In the mean time permit me to conclude in the language of the the moſt *divine Perſonage* that ever honoured this Globe with his preſence; a perſon to whom we are all infinitely indebted, and whoſe words ſhould have more influence in pointing out the neceſſity of this kind of learning, and urging our purſuits it it, than all the *ſtudied encomiums* of the moſt *pompous Writers* or Orators in the world.

"*If I have told you* EARTHLY *Things, and ye believe not, how ſhall ye believe if I tell you of* HEAVENLY *Things?*"

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* The velocity of the Wind is at the rate of 50 or 60 miles an hour in a great ſtorm, a common briſk Wind about 15 miles, and ſome move not one mile an hour.

SECTION XIII.

ASTRONOMY.

THE Author's deſign in this important branch of Philoſophy, is not to burthen the Reader's mind with a dry detail of intricate and abſtruſe calculations, but more immediately to inveſtigate the *Rationale* of things as better adapted to the capacities of juvenile Readers; as on the one hand he would ſtudiouſly avoid the imputation of Fanaticiſm, becauſe at times he betrays an anxious ſolicitude to vindicate the ways of God to Man, ſo on the other, he flatters himſelf, however volatile or diſſipated the manners of the age may be, no apology will yet be neceſſary for occaſionally introducing *Scripture Authorities*, as they not only contain indiſputable truths, but will alſo impreſs ſublime and pure ideas upon thoſe younger minds for whom this Treatiſe is chiefly intended.

The leaſt of the wonders here treated of is ſufficient to point out the *All-powerful Being*, but ſhould men refuſe their aſſent to theſe moſt plain and natural proofs, it looks as if they were well ſatisfied with their abſurdities; that is, with no proof of a Deity at all, or rather their vices make them reſolved not to yield aſſent.

In early ages when Arts began to be improved, Science began to dawn upon mankind, and as Virtue was found to be neceſſary for the preſervation of Society, its principles were inculcated, and mankind in general ſoon found the benefit of adhering to them; nor could Religion be neglected, Science and Religion go hand in hand with Virtue, when the precepts of pure morality began to be taught, the wiſe and good ſhewed how inſeperably they were connected with Chriſtianity. Papal Hypocriſy began to hide her face, and whatever fear or power might compel men to do, the ſenſible ſcrupled not in general in their hearts to deſpiſe the chains of Tyranny and Superſtition, and wiſhed alike for PURE RELIGION AND FOR EQUAL GOVERNMENT, while Commerce, which by this time had ſpread itſelf abroad amongſt mankind, and diſcovered to the riſing age WORLDS unknown to their Anceſtors, improved each finer art, and opened a new field to knowledge and refinement. But amongſt all the circle of the Sciences Aſtronomy ſeems to have claimed the earlieſt preference, which we ſhall now proceed to treat of.

ASTRONOMY is that refined Science which teaches us a knowledge of the Stars, and in general, of all the heavenly bodies, their form, ſtructure, appearances and motions, their poſitions in the Heavens, their magnitude and their diſtance, periods and Eclipſes; a large and extenſive field! but at this time much cultivated. Aſtronomy ſerves alſo to regulate the times and ſeaſons, determining the courſe of the year, and the length of its ſeveral parts; months, days, hours, *&c.* 'Tis by its aſſiſtance that we are able to diſcover the magnitude and the form of the Earth, for that Globe revolving round the Sun in the ſame manner with *Saturn*, *Jupiter*, *Mars*, *Venus*, and *Mercury*, is conſidered in Aſtronomy as a Planet, and it gives to Geography the ſeveral parts of the Globe with reſpect to one another, their extent and limits.—NAVIGATION owns it as the great guide, and it was with the one that the other became improved and flouriſhed. We read of Aſtronomy or ſome part of its diſcoveries in the earlieſt Authors, that are extant, and they treat of it as a thing long before them cultivated and highly valued, nor is it to be doubted that it was one of the firſt Sciences. * The heavenly bodies are of all viſible objects, thoſe which muſt have firſt attracted the attention of men; they are the moſt conſpicuous, the moſt beautiful, and the moſt important; it was natural to contemplate them, and they muſt have been very early found the only means of determining different periods of time for eſtabliſhing the neceſſary order and regularity in all the offices of Government and Religion.—The oldeſt books diſtinguiſh the periods of days, months and years, and the annual, or otherwiſe aſcertained returns of certain ceremonies; *and God ſaid let there be lights in the Firmament of the Heaven to divide the Day from the Night, and let them be for Signs and for Seaſons, and for Days and for Years*, Gen. i. ver. 14. for all which the obſervation of the *heavenly Bodies* muſt have been previouſly made, nor could any offices, ſacred or civil, be aſcertained in point of their duration without it. In the moſt ancient Authors of both ſacred and profane hiſtory, we read of divine honours paid to this Science. *He is wiſe in heart and mighty in ſtrength, who hath made* Arcturus, Orion, *the* Pleiades *and the chambers of the South*, Job ix, ver. 4, 9. It certainly ſeems to have inſpired great and good men with ſublime ſentiments; when the royal Prophet is moſt enraptured with his God, with what enlivened energy he deſcribes the great works of the Deity, when warm with divine ſenſations, he ſays, *the Heavens declare the glory of God, and the Firmament ſheweth his handy work, day unto day he uttereth ſpeech, and night unto night ſheweth knowledge,* Pſalm xix. ver. 2. The great Pſalmiſt goes ſo far as even to cenſure the groſs and ſenſual that pay no attention to this Science—when he ſays, *but this the unwiſe man doth not conſider, neither does a fool underſtand it,* and therefore muſt have a very inadequate idea of that powerful Creator who ſpoke this world of wonders into being, who divided the waving elements, and out of Chaos, formed by his plaſtic mandate, the unmeaſurable frame of this ſtupendous univerſe, who by his almighty fiat commanded light, when behold! inſtantly a flood of glory burſts from the Skies; 'twas then that the refulgent ſource of light and heat (the Sun) firſt ſprung through the blue expanſe of Heaven to enlighten, chear, and accommodate man; when we contemplate on theſe things, we may loſe ourſelves in *holy wonder*, and cry out with the Pſalmiſt, *Lord, what is man that thou art mindful of him, and the Son of man that thou ſhould viſit him!* and indeed, if we look upwards with *David* to the world above us, when we conſider the Heavens as the work of the finger of God, and the Moon and the Stars which he hath ordained, what amazing glories diſcover themſelves to our ſight, what wonders of wiſdom are ſeen in the exact regularity of their revolutions—*he eſtabliſhed the world by his wiſdom, and ſtretched out the Heavens by his underſtanding.*

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* For the heavenly bodies ſeem to have been the favourite inſtruments of the Almighty by which he thought proper to inform mankind, when he was about to indulge the human race with ſome particular marks of his benevolence. After the univerſal deluge, when the world was to be no more drowned, he ſays, *I have ſet my Bow in the Heavens*. When the Saviour is foretold, a glorious light appears to the Shepherds, the Heavens are filled with bright refulgent rays—a beautiful ſtar alſo appears and proves a friendly guide to diſcover the great *Immanuel*, it enlivened them, for when they ſaw the Star they rejoiced with exceeding great joy, *Matt.* ii. ver. 10.

In this divine Book the moſt unlettered may find enough to excite their admiration. As *Pope* ſays,

Lo! the poor Indian, whoſe untutor'd mind,
Sees God in Clouds, or hears him in the Wind.

Yet it will diſplay the greateſt wonders to thoſe who peruſe it with the cloſeſt attention; but then we muſt take care always to approach it as we ſhould the other Book of God, the Holy Scriptures, with reverence and humility, not having a too high opinion of our own abilities, as if we could with the line of human reaſon, fathom all the depths of the Divine Councels, *but thinking ſoberly as we ought to think.*

Dr. *Watts* in the Preface to his *Treatiſe of Aſtronomy* ſays, there never was any thing contributed to enlarge his apprehenſions of the immenſe power of God, the magnificence of his Creator, and his own tranſcendent grandeur, ſo much as that portion of *Aſtronomy* which he had obtained, and ſtrongly recommends it to young perſons for the ſame purpoſe. But I would perſuade all mankind (if it were poſſible) to gain ſome degree of acquaintance with the magnitude, diſtance and motions of the Planetary Worlds. It refines the ideas, gives an unknown enlargement to the underſtanding, enlivens the active principle within us, and affords a divine entertainment to the ſoul, and its better power to an undevout Aſtronomer is made, and thus from beholding the wonders of the Creation we are brought to adore the wiſdom, power, and goodneſs of the Creator. With what pleaſure and rich profit would men ſurvey thoſe aſtoniſhing *ſpaces* in which the Planets revolve, the immenſity of their bulk, and the almoſt incredible ſwiftneſs of their motion, and yet all theſe governed and adjuſted by ſuch unerring rules that they never deviate from their tracks, nor loſe a minute of their time, nor change their appointed circuits in ſeveral thouſand years. *The works of the Lord are great, ſought out of all them that have pleaſure therein;* he hath ſo done his marvellous works that they ought to be had in remembrance.

SECTION

SECTION XIV.

The Phænomenon of the HEAVENLY BODIES.

ASTRONOMY, with the utmoſt propriety, may be ſaid to enlarge the mind in ſubmitting the very courſe of the heavenly bodies to our underſtanding, and to join with the merit of doing mankind many ſignal ſervices, that of affording motives both of a lively gratitude and of the moſt profound veneration. We have already deſcribed the Globe of the Earth; were it poſſible to ſuſpend that immenſe Globe at as great a diſtance from the eye as the Moon, it would appear flat and circular, and the greatneſs of the diſtance would make the convexity imperceptible, and would therefore reſemble the Moon juſt as ſhe appears to us when at the full. Suppoſing then the Sun and Moon are vaſt ſpherical bodies, like this our Earth, and that they are placed at a great diſtance from us, they muſt alſo appear flat and round, and not ſpherical; and ſince they do appear ſo, they are undoubtedly ſpherical bodies. But this is confirmed by ſome of the celeſtial bodies turning conſtantly round their Axis, and thereby they diſcover ſucceſſively to us all their different ſides; and ſince in every poſition they appear round, their figure muſt be ſpherical. It might be aſked why none of the other Celeſtial Bodies appear ſo large as the Sun or the Moon? Suppoſe a ſixteen inch Globe, or a much larger placed a mile diſtance from us, it could hardly be ſeen, or at beſt appear very ſmall; from thence you may imagine that the Sun is much larger, as he appears the ſame 1000 miles off as here. If the Sun was removed to a greater diſtance from us, or, which comes to the ſame thing, if we were carried away with our Earth to a greater diſtance from him, he would ſtill appear leſs and leſs; and if the diſtance be properly increaſed, he would in time appear only like one of the biggeſt Stars, and afterwards like one of the ſmaller, and at laſt we ſhould loſe ſight of him altogether. It is quite inconceivable, at what immenſe diſtances ſome of the *Shining Bodies* in the Sky are placed from us; which will be of great uſe to be remembered that you may upon occaſion call them to mind. When you conſider the diſtance betwixt us and the Antipodes, is little leſs than 8000 miles, it may ſeem wonderful that ſuch a vaſt Globe ſhould be ſuſpended in the ambient ſpace of the Univerſe! And how muſt it heighten our ſurprize, when we take a ſurvey of the multitude of vaſt Globes continually rolling over our heads! The Moon performs her courſe at the diſtance of about 240,000 miles from the Earth. A ſpectator placed in the Moon, looking towards the Earth, would obſerve it in the Heavens, and the face of it would appear fifteen times bigger than the face of the Moon does here. The Moon is placed at ſo little a diſtance from us, (compared to the diſtance of the other Celeſtial Bodies) that it alone throws a greater quantity of Light upon us than all the Stars together, though theſe be as many Suns.

The Creator has removed the Stars ſo very far from us, or keeps us ſo far from them, that the Light we ſtand in need of cannot be impaired by their brightneſs; and he has ſituated the Moon ſo near us, that it becomes a magnificent glaſs, which returns to us in the Night a great part of the Light of the Sun. This faithful Satellite offers to all nations of the Earth a watch-light, which takes every ſeven days a form entirely new. The *Hebrews*, *Greeks*, the *Romans*, and all the Ancients in general, uſed to aſſemble at the time of the New Moon, to diſcharge the duties of piety and gratitude, for the manifold uſes of this heavenly body, which it will never fail to afford us, till He, who for our ſake has appointed them, ſhall think fit to change its properties with the ſtate of man.

We find the characters and marks of an expreſs Will, full of tenderneſs towards us in all the numberleſs bleſſings, which God multiplies from year to year and from day to day, both upon and within the Earth. But with what ſplendour and magnificence does that Will ſhew itſelf in the beauty of the Sun, and in the juſt proportion of ſize, diſtance, action and uſefulneſs, that has been eſtabliſhed between that and the Earth.

As large as the Globe of our Earth is, the Sun's glorious body is almoſt a million of times bigger. The Moon revolves round the Earth in an extreme large Orbit. Now was the Sun placed where the Earth is, it would more than fill the whole Orbit of the Moon, and even extend beyond the Moon. Prodigious! It is not therefore without reaſon, that we call this glorious body a vaſt Ocean of Heat and Light. What a ſmall thing is our Earth in compariſon of the Sun; how is it ſhrunk up! We now no longer wonder that the Sun ſhould appear equally big over the whole face of the Earth; for this is only to appear equally big over the whole ſurface of a Point. Nor is the reaſon hard to be found out, why he ſhould be ſuch a vaſt body, as its heat and light were to be diffuſed through the whole ſyſtem of wandering Globes, that ſtand in conſtant need of his enlivening rays and aſſiſtance. In the whole immenſity of the Heavens, this glorious body alone, when he appears,

pears, ſtrikes our eyes, and overſpreads Nature with ſplendour and glory; but during his abſence we perceive an innumerable multitude of Fires or Stars on every ſide; and yet this ſingle flambeau, when he aſcends the Heavens with a majeſtick ſtate, makes us amends for the loſs of the other Lights, drowning them all by the ſuperiority of its own. We ſhall be amazed at the thoughts of what the moſt learned and moſt exact Aſtronomers ſay concerning the diſtance of the Sun from us, being near ten thouſand diameters of the Earth from it; that is, near 80,000,000 miles. To make you more ſenſible what a prodigious diſtance it is, let us take poſt and ſtart from the Earth, in order to get to the Sun, and travel at the rate of one hundred miles a day without faintneſs or interruption; we muſt travel more than 2000 miles a Year to arrive at that luminary. What then can be that Globe, which alone cauſes a general renewal at the very inſtant of its appearance? Is it a Globe wholly compoſed of Fire? How can it operate ſo powerfully and at ſo vaſt a diſtance? How comes it, during the ſix thouſand ſucceſſive years it has lighted and heated Nature, not to have loſt the greateſt part of its ſubſtance by the conſtant effluvia of it emitted therefrom? You may perhaps hereaſter have the moſt plauſible Anſwers that can be made to theſe Queries:—God hides from us nothing but what is uſeleſs or dangerous.

SECTION XV.

Of the Syſtem of the WORLD.

THE ſyſtem of the World is the whole collection of thoſe great bodies which compoſe the Univerſe of material beings, *viz.* the *Stars* the *Sun*, the *Planets*, and *Comets*, with the indefinitely extended ſpace in which they are contained. The true *Solar Syſtem* was firſt invented by *Pythagoras*, the *Samian*, 500 years before the birth of Chriſt. After this time it lay dormant till again revived by *Nicholas Copernicus*, a nobleman of *Thorn*, in *Pruſſia*, and was, by our great Sir *Iſaac Newton*, eſtabliſhed on ſuch clear and ſolid principles, that it is now univerſally received.——THIS SYSTEM is arranged in the following manner (as in the oppoſite figure). The Sun (a vaſt globe of fire) is placed in the center, from whence it never * moves. Around him, at unequal diſtances, ſix opaque globes continually revolve.—Theſe are called PLANETS. That which is neareſt the Sun is called ☿ *Mercury:* the next ♀ *Venus:* then our ⊕ *Earth:* the next beyond is ♂ *Mars:* after him is ♃ *Jupiter:* and the moſt diſtant of all is ♄ *Saturn.*——♄ Saturn, ♃ Jupiter, and ♂ Mars, are called *Superior Planets*, becauſe their circuits are *beyond* the Earth's orbit: ☿ Mercury and ♀ Venus are termed *Inferior Planets*, becauſe their circuits are *within* the Earth's orbit. Beſides theſe, there are diſcovered in this ſyſtem ten other bodies, which move about ſome of theſe planets in the ſame manner as the planets move round the Sun. Theſe are called *Satellites*, or Moons; and one of the moſt conſpicuous of them is the Moon which moves round our Earth; four circulate, in like manner, round Jupiter; and five Moons attend upon Saturn.

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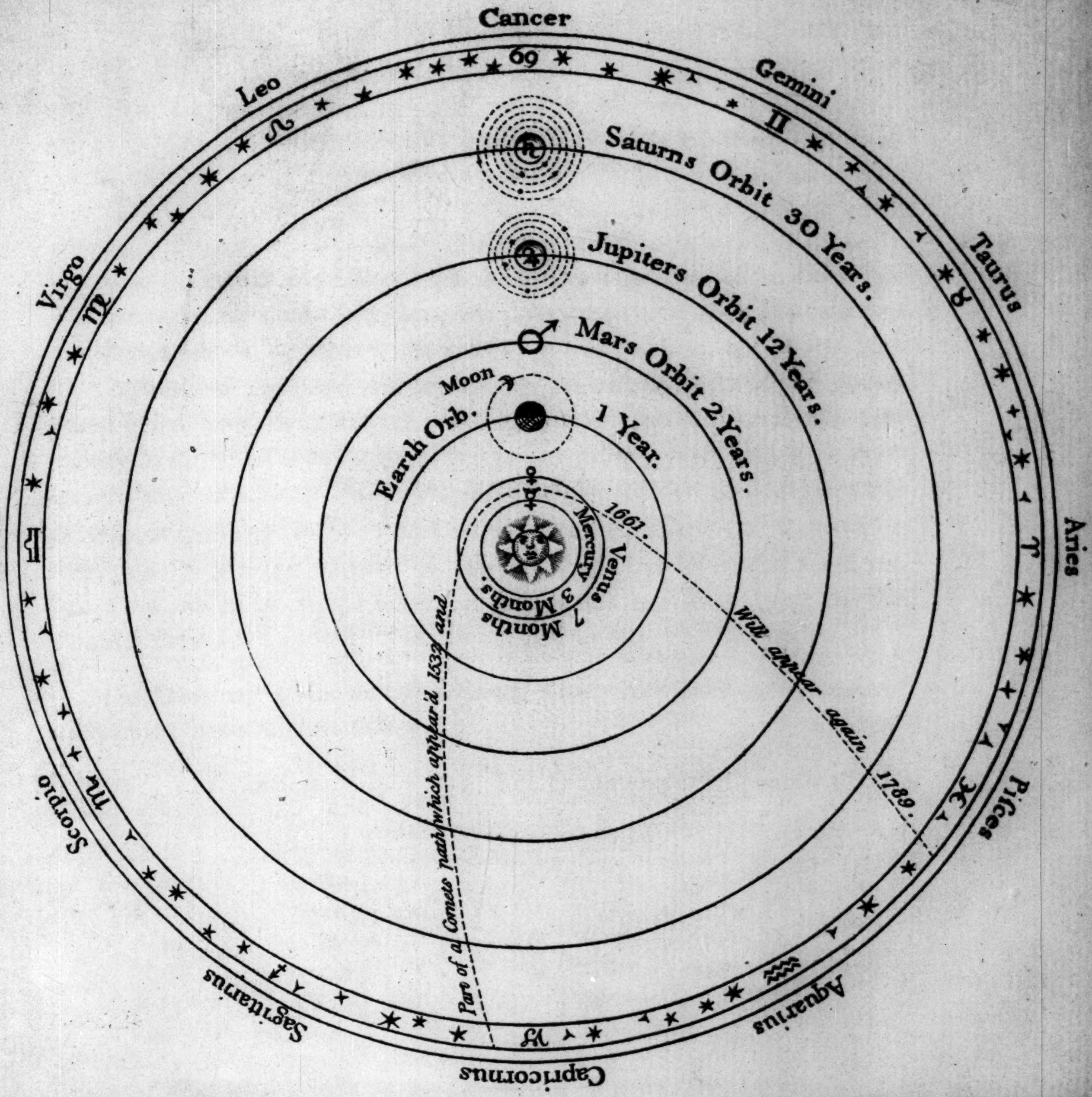
* The Sun has a motion round his axis in 25 days 6 hours, as is evident by ſpots ſeen on his ſurface. His circumference is two million three hundred ninety-eight thouſand miles; and by the various attractions of the circumvolving Planets, he is agitated by a ſmall motion round the centre of the Syſtem: but this circle is ſo exceeding ſmall in proportion to the Sun's bulk and diſtance, that aſtronomer's take no notice thereof, but call the Sun a fixed body.

The

The SYSTEM *of the* WORLD – *or* SOLAR SYSTEM.



J. Lodge Sculp.

The Characters of the Planets (which ſhould be attended to and learnt) are as follow, with the common calculation of the diſtance of each Planet from the Sun in Engliſh miles:

Characters.

☿	*Mercury*	32	millions of miles diſtant from the Sun.
♀	*Venus*	59	
⊖	*Earth*	81	
♂	*Mars*	123	
♃	*Jupiter*	424	
♄	*Saturn*	777	

The diſtance of the Moon from the Earth is about 240,000 miles, and is in magnitude about fifty times leſs than the Earth. The Sun is near a million of times bigger than the Earth.

To aſſiſt the imagination in conceiving the vaſt diſtances of the Planets and Stars, let us ſuppoſe that a body projected from the Sun ſhould continue to fly with the ſwiftneſs of a cannon bullet, which is 480 miles every hour, this body would reach the orbit of ☿ Mercury in 7 years 221 days; of ♀ Venus in 14 years 8 days; of the ⊖ Earth in 19 years 91 days; of ☿ Mars in 29 years 65 days; of ♃ Jupiter in 100 years 280 days; would arrive at ♄ Saturn in 184 years 240 days; and to the neareſt fixed ſtar in about ſeven million ſix hundred thouſand years.

The Diameters of the Sun, the Earth, and each of the Planets, in Engliſh miles, are nearly as follow:

	Diameters.*		
♄	*Saturn*	67,900	miles.
♃	*Jupiter*	81,200	
♂	*Mars*	4,444	
⊖	*Earth*	7,900	
☽	*Moon*	2,175	
♀	*Venus*	7,900	
☿	*Mercury*	2,460	
☉	*Sun*	764,300	

	The circumference of the Planets.		
☿	*Mercury*	13,350	miles.
⊖	*Earth*	25,000	
☽	*Moon*	6,836	
♂	*Mars*	13,297	
♃	*Jupiter*	254,469	
♄	*Saturn*	191,637	

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* Diameter is a right line that goes through the center of any Circle.

All theſe Planets (with their Moons) being opaque bodies, and receiving the whole of their light from the Sun *, as well as making their great revolutions round him, are for theſe reaſons eſteemed as dependants upon that univerſal fountain of heat and light. The *Planets* all move one way from *Weſt* to *Eaſt*. The time which each Planet takes in revolving round the Sun, is in round numbers nearly as follows: ☿ *Mercury* goes round the Sun in three months; ♀ *Venus* in ſeven; the ⊖ *Earth* in twelve, or a year; ♂ *Mars* in two years; ♃ *Jupiter* in twelve; and ♄ *Saturn* in thirty years.

Comets (or blazing Stars) are celeſtial bodies in the planetary region, appearing ſuddenly and again diſappearing. A Comet is diſtinguiſhed from other Stars by a long train or tail of Light oppoſite to the Sun; it performs its revolutions about the Sun's eliptical orbits (as repreſented in the Figure) which has the Sun in one of the focuſes, the other extends far beyond the ſphere of ♄ *Saturn*, ſo that the revolutions of any are not performed in leſs than ſeventy or eighty years. Comets when viewed through a Teleſcope, have a moſt awful appearance, being large globular bodies with long blazing tails, and ſomething like fiery darts or ſtreams of burning rays about the Globe itſelf.

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* *Milton* finely deſcribes the magnificence of the Deity, in the fourth day of the Creation.

> First in his Eaſt the glorious Lamp was ſeen,
> Regent of day; and all th' Horizon round
> Inveſted with bright rays, jocund to run
> His longitude thro' Heaven's high road: the gray
> Dawn and the *Pleiades* before him danc'd,
> Shedding ſweet influence. Leſs bright the Moon,
> But oppoſite in level'd Weſt was ſet,
> His mirror, with full face borrowing her light
> From him; for other light ſhe needed none
> In that aſpect: and ſtill that diſtance keeps
> Till night; then in the Eaſt her turn ſhe ſhines,
> Revolv'd on Heav'n's great axle, and her reign
> With thouſand leſſer lights dividual holds,
> With thouſand thouſand Stars! that then appear'd
> Spangling the Hemiſphere.———

By this account of *Milton*'s it ſhould ſeem the firſt Moon that appeared was at full.

Various have been the conjectures relative to this ſurprizing phænomenon; ſome think they ſerve to recruit the expence of the Sun and Planets, others think they are ſent as portentious warnings to mankind, *&c.* But in truth, all theſe conjectures rather ſhew that *natural impatience* which is planted in the mind of man of being ignorant, than their ability to find out the true reaſon. How various and wonderful are the works of God? This is a new and tremendous ſcene? It is not without reaſon been ſaid, that we ought to adore and reverence a knowledge ſuperior to our own, even in thoſe things whoſe uſe and nature we cannot ſo much as gueſs at; how dreadful is the power of that *Almighty arm* which ſo projects theſe unknown bodies, that they paſs without the limits of our World with ſuch meaſured force, that they return from thence inſtead of flying off to other Regions of the univerſe, with ſuch direction and ſkill, that they do not daſh againſt the Planets and bear down the habitable Globes of our ſyſtem. What an inſtance this of divine power and clemency.

The MOON moves round our Earth in the ſame manner as the Earth does round the Sun, and performs her revolution in twenty-ſeven days, ſeven hours and forty-three minutes; this Planet is different from all the reſt, reſpects our Earth for her centre, and not only her Globe, but her whole orb and ſyſtem is carried round the Sun along with our Earth in the ſpace of a year; by this motion of the Moon round the Earth, are occaſioned the Eclipſes of the Sun and Moon, and the ſeveral appearances, aſpects, or phaſes ſhe at different times puts on, for when the Earth is ſo ſituated between the Sun and the Moon that we ſee all her enlightened parts, it is * *full Moon.* When the Moon is ſo ſituated be-

tween

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* The beauty of a fine *Moon-light night* is finely deſcribed by *Homer.*

So when the Moon, refulgent lamp of night,
O'er Heaven's clear azure ſpreads her ſacred light;
When not a breath diſturbs the deep ſerene,
And not a cloud o'er caſts the ſolemn ſcene;

Around

tween the Sun and the Earth that her enlightened parts are hid or turned from us, it is a New Moon, and when her ſituation is ſuch that only a portion of her enlightened parts are hid from us, we ſee a *horned Moon*, a *half Moon*, or a *gibbous Moon*; according to the quantity of the enlightened part we can perceive, the horns of the Moon are always turned from the Sun. Providence has thus bleſt us with this ſerene and uſeful Light to accommodate and cheer the world in the abſence of the Sun. GOD *made two* GREAT LIGHTS, *the greater Light to rule the Day, and the leſſer Light to rule the Night; he made the* STARS *alſo, and* GOD *ſet them in Firmament of the Heavens to give light upon the Earth, and to rule over the Day and over the Night, and to divide the Light from the Darkneſs, and* GOD *ſaw that it was good.* Geneſis i. ver. 16, 17, 18.

One Sun by Day, by Night ten thouſand ſhine,
And light us deep into the Deity.

The total or longeſt Eclipſe of the Moon happens when the Earth is directly between the Sun and the Moon, and prevents the light of the Sun from falling upon, and being reflected by the Moon.

STARS eſſentially differ from Planets, Stars ſhining with their own native light, but Planets ſhines with only that borrowed light they receive from the Sun. Hence the Stars in the Heavens are always to be diſtinguiſhed from the Planets, for the fixed Stars twinkle, but the Planets ſhine with a ſteady light. Far beyond the Planets the Almighty Architect has placed the fixed Stars at ſuch an immenſe diſtance, that

Around her Throne the vivid Planets roll,
And Stars unnumber'd gild the glowing Pole;
O'er the dark trees a yellow verdure ſhed,
And tip with ſilver ev'ry Mountains head:
Then ſhine the Vales, the Rocks in proſpect riſe,
A flood of glory burſts from all the Skies:
The conſcious ſwains, rejoicing in the ſight,
Eyes the blue vault and bleſs the uſeful light.

the beſt Teleſcopes repreſent them but as points *; they are called fixed Stars, becauſe from all ages they have not been obſerved to change their ſituation, and comprehend within their immenſe circle all the orbits and excurſions of the Sun, Earth, and Planets. Hence it is uſual to denote the place of any Planet, by obſerving under which of the *Signs* amongſt the fixed Stars that Planet moves; what is meant by *Signs* is a portion of thoſe fixed Stars which are near to one another, was ſuppoſed by the Antients to repreſent ſome animal or other thing; as a Ram, a Bull, a Lion, *&c.* called Signs, and by this method *they* depictured in Heaven *twelve of theſe Signs,* which formed what they termed the Zodiac, which is that extenſive circle of Stars *that* ſurrounds our whole ſolar Syſtem. The name of the twelve Signs of the Zodiac, and the time when the † Sun enters into each of them, are as follows:

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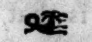
* It is not to be imagined that all the Stars are placed in one concave ſurface, ſo as to be equally diſtant from us, but that they are ſcattered at vaſt diſtances from one another through unlimited ſpace, ſo that there may be as great diſtance betwixt any two of the nearer Stars, as betwixt our Sun and them. Hence a ſpectator who is neareſt to any fixed Star, will look upon it as a real Sun, and conſider thoſe more remote as ſo many ſhining points fixed at equal diſtances from him in the Firmament. Was our Sun as far from us as a Star, it would appear no bigger to us than a Star.

† In order to make this comprehenſive and eaſy to the unſkilful, we here ſpeak of the Sun according to the general idea as moving through the Signs of the Zodiac, when in reality it is the Earth moving round the Sun occaſions the Sun, which is a fixed body, to appear to move.

The Sun enters into	♈ *Aries*	The Ram		*March* 21.
	♉ *Taurus*	The Bull		*April* 20.
	♊ *Gemini*	The Twins		*May* 21.
	♋ *Cancer*	The Crab		*June* 21.
	♌ *Leo*	The Lion		*Jnly* 23.
	♍ *Virgo*	The Virgin		*Auguſt* 23.
	♎ *Libra*	The Balance		*September* 23.
	♏ *Scorpio*	The Scorpion		*October* 23.
	♐ *Sagittarius*	The Archer		*November* 22.
	♑ *Capricornus*	The Goat		*December* 22.
	♒ *Aquarius*	The Water		*January* 20.
	♓ *Piſces*	The Fiſhes		*February* 19.

It is alſo neceſſary to underſtand thoſe Signs that are OPPOSITE each other, as it ſhews the different times and ſeaſons of the year :

* Correſponding	♈ *March*	♎ *September*	By the progreſſive motion of the Earth, the Sun appears to paſs thro' all theſe Signs in a year.
	♉ *April*	♏ *October*	
	♊ *May*	♐ *November*	
	♋ *June*	♑ *December*	
	♌ *July*	♒ *January*	
	♍ *Auguſt*	♓ *February*	

It has been ſhewn, that the Stars are fixed bodies—That the Sphere of thoſe fixed Stars is divided into 12 Signs—That the *Planets* change their places under theſe *Signs* or fixed Stars, by which motion the Planets came firſt to be diſtinguiſhed from the Stars, and to have their motions obſerved, and their cauſes enquired into. But Aſtronomy is now ſo much improved, that we are able to calculate, and moſt accurately diſcover, not only under what Sign of the Zodiac any of the Planets will or have appeared, but alſo in what part of the heavens, and when viſible or inviſible, for any future, paſt, or preſent time, which are moſt accurately ſet forth in the *Ephemeris**, and proves extremely uſeful: but not being in the hands of every one, are not generally underſtood; I have therefore inſerted and explained a part of Mr. *White*'s Ephemeris, as on the other ſide, which, by a little attention, will afford the reader a competent knowledge of thoſe curious and uſeful cœleſtial Diaries.

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* What is meant by CORRESPONDING is, that the Sun is in the Equator, or middle of the Earth, in *March* and *September*. The Declination of the Sun from the Equator the ſame in *April* as *October*, &c. All which will be explained under its proper head.

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* *Ephemeris*, from the Greek ἡμέρα, is an aſtronomical table calculated to ſhew the diurnal motion of the Planets, their places, aſpects, &c.

Part

Part of an EPHEMERIS for *March*, this preſent Year 1774.

1	2			3		4		5		6		7		8		9	
Days	☉ d.	m.	♓ s.	☽	♎	Lat.	☽	♄	♍ R.	♃	♈	♂	♓	♀	♈	☿	♓
1	11	2	13	19	33	2N.	26	23	43	12	31	2	33	11	2	13	21
2	12	2	19	3♏	31	3	30	23	39	12	44	3	21	11	3	15	17
3	13	2	23	17	36	4	21	23	34	12	58	4	8	11 ℞	1	17	13
4	14	2	26	1♐	46	4	58	23	30	13	11	4	56	10	57	19	9
5	15	2	27	15	57	5	16	23	25	13	25	5	43	10	50	21	6
B	16	2	25	0♑	8	5	15	23	20	13	39	6	30	10	41	23	4
7	17	2	20	14	19	4	55	23	16	13	53	7	17	10	30	25	2
8	18	2	13	28	24	4	20	23	11	14	6	8	4	10	16	26	59
9	19	2	3	12♒	18	3	24	23	6	14	20	8	52	9	59	28	56
10	20	1	52	26	10	2	20	23	1	14	34	9	39	9	40	0♈	52
11	21	1	38	9♓	45	1	9	22	56	14	48	10	26	9	19	2	46
12	22	1	22	23	5	0S.	5	22	52	15	2	11	13	8	55	4	39
B	23	1	5	6♈	8	1	16	22	47	15	16	12	0	8	29	6	30
14	24	0	44	18	55	2	23	22	42	15	30	12	47	8	1	8	19
15	25	0	23	1♉	26	3	21	22	38	15	44	13	34	7	31	10	5
16	25	59	59	13	41	4	9	22	33	15	58	14	21	7	0	11	47
17	26	59	34	25	47	4	45	22	28	16	12	15	8	6	27	13	25
18	27	59	7	7♊	45	5	8	22	24	16	26	15	55	5	52	15	0
19	28	58	39	19	39	5	18	22	19	16	40	16	42	5	16	16	31
B	29	58	10	1♋	33	5	13	22	14	16	54	17	29	4	39	17	56
21	♈	57	38	13	31	4	56	22	10	17	8	18	16	4	2	19	15
22	1	57	3	25	40	4	25	22	5	17	23	19	3	3	24	20	28
23	2	56	25	8♌	1	3	42	22	0	17	37	19	50	2	47	21	35
24	3	55	45	20	40	2	47	21	56	17	51	20	37	2	9	22	36
25	4	55	4	3♍	38	1	42	21	51	18	5	21	24	1	32	23	30
26	5	54	21	17	0	0	30	21	47	18	20	22	11	0	55	24	18
B	6	53	36	0♎	42	0N.	46	21	42	18	34	22	58	0	19	24	58
28	7	52	49	14	44	2	1	21	38	18	48	23	44	29♓	44	25	31
29	8	51	59	29	1	3	9	21	33	19	3	24	31	29	10	25	56
30	9	51	7	13♏	28	4	7	21	29	19	17	25	18	28	37	26	15
31	10	50	14	28	0	4	48	21	24	19	31	26	5	28	6	26	26

Days	Day increaſ.		Length of Day.		Helioc. Plac. ♄		Helioc. Plac. ♃		Helioc. Plac. ♂		Helioc. Plac. ⊖		Helioc. Plac. ♀		Helioc. Plac. ☿		Saturn riſes.
1	3	9	10	53	22♍	24	18♈	32	26♒	29	11♍	2	27♌	19	19♓	43	6A.23
7	3	33	11	17	22	36	19	5	0♓	16	17	2	7♍	4	19♈	44	5 59
13	3	57	11	41	22	49	19	38	4	5	23	1	16	48	24♉	53	ſets
19	4	21	12	5	23	1	20	10	7	53	28	59	26	32	2♋	36	6M14
25	4	45	12	29	23	13	20	43	11	42	4♎	55	6♎	14	8♌	8	5 50

SECTION XVI.

Explanation of the EPHEMERIS.

AN Ephemeris is a Diary or Daily Regiſter of the motions and places of the heavenly bodies, ſhewing the different ſituation of every Planet as they are poſited at 12 o'clock each day. The firſt column, where *Days* are wrote, are the days of the week; the ſecond column, marked 2, deſcribes what ſign of the Zodiac the Sun occupies; on the top of this column are theſe characters, (☉ ♓) which ſignifies the Sun ☉ is in the Sign ♓ *Piſces*, underneath is d. m. s. which ſignifies degrees, minutes, and ſeconds; thus on the firſt day of *March* 1774, the Sun is 11 deg. 2 min. 13 ſec. in *Piſces*; but on the 21ſt of *March*, the Sun enters into ♈ *Aries* 57 min. 38 ſec. &c. The third column (☽ ♎), Moon in *Libra*, ſhows the Moons progreſs through the Signs, and being a Planet very ſwift in motion, runs through all the Signs in the ſpace of a month; hence it is the Turks meaſure all their time by this motion of the Moon, as they do not count by Years, but ſay ſo many Moons; the fourth column, (Lat. ☽) gives you the Moon's Latitude, the orbit in which the Moon moves croſſes the Sun's orbit; the Moon is therefore ſometimes Northward and ſometimes Southward of the * Ecliptick,

or

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* The Ecliptic is a great circle of the Sphere, ſuppoſed to be drawn through the middle of the Zodiac, making an angle with the Equator of about 23 deg. 30 min. which is the Sun's greateſt declination; or more ſtrictly ſpeaking, it is the path or way amongſt the fixed Stars that the Earth appears to deſcribe to an eye placed in the Sun: ſome call it the way of the Sun, becauſe the Sun in his apparent annual motion never deviates from it, as all other Planets do more or leſs. It is called Ecliptic by reaſon all Eclipſes happen when the Planets are in it. Thus we ſee the great ſkill and wiſe order of *Providence*, in allotting the Moon a different orbit from the Sun, for was the Moon to deſcribe the ſame path in the Heavens as the Sun, though in a leſſer orbit, we ſhould have Eclipſes twice a month, that is every full and new Moon, and thoſe who inhabit at the extremities of the Earth that is near either the North or South Pole, would have a horrid dark night of ſix months in the year; as it is, they are deprived of the Sun for ſix months, but the Moon moving in a different orbit from the Sun, does frequently afford thoſe Polar regions a chear-

ful

or the Sun's path, and is therefore ſaid to have North or South Latitude, which is deſcribed in the column by the letter N or S, and whenever an O is ſeen in the column of the Moon's latitude, it ſignifies the Moon has no Latitude, but is then in the Ecliptic; if at this time the Sun ſhould be in the ſame, or in the oppoſite ſign to which the Moon is in there muſt be an Eclipſe; thus you will ſee on the 12th of *March* the Moon is in ♓ *Piſces*; the Sun is alſo in the ſame ſign, and the Moon has no Latitude, conſequently there will that day be a *Solar Eclipſe*, as the Moon will then be exact between our Earth and the Sun; had the Moon been in ♍ *Virgo*, which is the oppoſite Sign to ♓ *Piſces*, it would then have been *a Lunar Eclipſe*, as the Earth would then have interpoſed between the Sun and Moon, and by the Sun the Earth's ſhadow would have been reflected upon the Moon, and thus cauſed a *Lunar Eclipſe*. But to proceed, the fifth column ſhews the motion and place of ♄ *Saturn*, the ℞ at the top implies that Planet to be retrograde, that is, it ſeems to move backwards in the Heavens contrary to the *Signs*, which is from Weſt to Eaſt, but ♄ *Saturn* at this time appears to move from Eaſt to Weſt, therefore ſaid to be retrograde; but on the 21ſt of *May*, will apparently alter his courſe and move direct according to the Signs, therefore a D is placed in the Ephemeris at that time for direct. The ſixth column is ♃ *Jupiter*, that ſerene bright Planet in ♈ *Aries*; the ſeventh column you have fiery ♂ *Mars* in ♓ *Piſces*; the eighth column deſcribes ♀ *Venus*, that beautiful Planet in ♈ *Aries*, and ſparkling ☿ *Mercury* is ſeen to be in ♓ *Piſces*. By a ſmall attention to theſe Planets and Signs, you will obſerve that at the begining of *March* 1774, ♃ *Jupiter* and ♀ *Venus* are both in one Sign, which is called a * Conjunction, conſequently at this

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ful and pleaſing light, continually ſhining with them day and night for near a fortnight together without ſetting; during the whole time the Sun never once riſes above their Horizon, conſequently would be in utter darkneſs if not thus providentally aſſiſted by this ſerene and uſeful Lunar Orb.

* Aſtronomers mark a Conjunction in this manner, ☌ which ſignifies two or more Planets to be under one *Sign*, and therefore very near each other; thus a *New Moon* is ſaid to be in ☌ *conjunction* with the Sun; an Oppoſition is thus marked, ☍ which implies two Planets to be oppoſite each other—thus the *full Moon* is always in ☍ oppoſition or in the oppoſite Sign to the Sun, the Earth is always oppoſite the Sun.

this time thoſe two large and beautiful Planets will be ſeen in the Heavens very near each other, and afford a very auguſt and pleaſing ſight; the Sun being in ♓ *Piſces* and ♃ *Jupiter*, and ♀ *Venus* being in ♈ *Aries*; the next following Sign, ſhews that juſt after Sun ſet thoſe planetary Globes will make their appearance in the *Weſt*. *Saturn* we have ſaid to be in ♍ *Virgo*, which is oppoſite ♓ *Piſces*; the Sun's place therefore, as the [*] Sun ſets, ♄ *Saturn* will riſe, and at 12 o'clock at night, when the Sun is quite under our Earth, ♄ *Saturn* will be in our Zenith, that is almoſt over our heads, and ſhine very conſpicuous in the Heavens. Having thus explained the Ephemeris, a very little application will inable any perſon to thoroughly underſtand it.

For Example. I would wiſh to know the reſpective Signs in which the ☉ *Sun*, ☽ *Moon*, ♄ *Saturn*, ♃ *Jupiter*, ♂ *Mars*, ♀ *Venus*, and *Mercury* will appear in on the fourth of *March* 1774; by inſpecting the Ephemeris, the above Planets are diſcovered to be in the undermentioned Degrees of the following Signs:

The ☉ *Sun* in 14 deg. 2 min. 6 ſec. of ♓ *Piſces*.
The ☽ *Moon* in 1 deg. 46 min. of ♐ *Sagittarus*.
♄ *Saturn* in 23 deg. 30 min. of ♍ *Virgo*.
♃ *Jupiter* in 13 deg. of ♈ *Aries*.
♂ *Mars* in 4 deg. of ♓ *Piſces*.
♀ *Venus* in 10 deg. of ♈ *Aries*.
☿ *Mercury* in 19 deg. of ♓ *Piſces*.

Thus you have the true place of all the Planets for the 4th of *March* 1774.

Again, it is required to know by the Ephemeris, where the Planets are ſituated on the 30th of *March* 1774.

Upon inſpection you will find the ☉ *Sun* 9 deg. 51 min. 7 ſec. in ♈ *Aries*; ☽ the *Moon* 13 deg. 28 min. in ♏ *Scorpio*; *Moon*'s Latitude 4 deg. 7 min. North; ♄ *Saturn* 21 deg. 29 min. in ♍ *Virgo*; ♃ *Jupiter* 19 deg. 17 min. in ♈ *Aries*; ♂ *Mars* 25 deg. 18 min. in ♓ *Piſces*; ♀ *Venus*

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[*] For although our Earth (as before obſerved) is uſually treated of according to appearances, as if the Sun, Moon, and Stars roſe every day in the Eaſt and ſet in the Weſt, it is generally known that the Earth turns round upon its own Axis from Weſt to Eaſt every 24 hours, which occaſions thoſe appearances.

28 deg. 37 min. in ♓ *Piſces*; ☿ *Mercury* 26 deg. 15 min. in ♈ *Aries*; and thus you have the true place of all the Planets, for the 30th of *March* 1774.

What we have now been ſpeaking of is called the *Geocentrick * places of the Planets*, that is ſeen from, or having the Earth for its center. The *Heliocentrick † places* of the Planets, means, was it poſſible for an eye to be placed in the Sun, it would ſee our Earth as a Planet, and gives the places of all the Planets as they would appear from this ſituation of the obſerver, and thoſe Heliocentrick aſpects you have at the bottom of the Ephemeris, and calculated for every ſeven days. Thus a ſpectator in the Sun would, on the 1ſt of *March*, ſee our ⊖ Earth in the Sign ♍ *Virgo* (in the fourth colum of the *Heliocentrick Motions*) which muſt be the caſe, for if on the Earth we ſee the Sun in the Sign ♓ *Piſces*, conſequently at the Sun our ⊖ Earth muſt appear in the oppoſite Sign ♍ *Virgo*; but this will be more clearly explained when we treat of the Orrery, and to ſhow how materially the Earth and Planets in a few Months alter their ſituation, I have inſerted another page of the Ephemeris for *September* 1774.

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* *Geocentric*, from the Greek *για*, *the Earth*, and *κιντρον*, *the Center*, i. e. any Planet reſpecting the Earth as its center.

† *Heliocentric*, from *ἥλιος*, *the Sun*, and *χιντρον*, *the Center*, ſignifies any Planet or orb, that has the Sun for its Center.

Part of an Ephemeris for *September*, this preſent Year 1774.

1	2			3		4		5		6		7		8		9	
Days	☉ d.	m.	♍ s.	☽	♋	Lat.	☽	♄	♍	♃	♉	♂	♋	♀	♌	☿	♌
1	9	1	19	17	9	4	S.24	26	48	16	6	15	56	7	47	21	39
2	9	59	30	29	7	3	41	26	55	16	7	16	34	9	1	22	17
3	10	57	42	11 ♌	14	2	49	27	2	16	7	17	11	10	14	23	4
B	11	55	56	23	33	1	47	27	9	16 ℞	7	17	49	11	26	23	59
5	12	54	12	6 ♍	4	0	40	27	16	16	7	18	26	12	38	25	0
6	13	52	30	18	49	0	N.31	27	23	16	7	19	4	13	51	26	8
7	14	50	49	1 ♎	50	1	42	27	31	16	6	19	41	15	3	27	22
8	15	49	10	15	5	2	48	27	38	16	6	20	18	16	16	28	42
9	16	47	33	28	33	3	46	27	45	16	5	20	55	17	28	0 ♍	8
10	17	45	58	12 ♏	14	4	33	27	53	16	4	21	32	18	41	1	39
B	18	44	25	26	5	5	4	28	0	16	2	22	9	19	54	3	14
12	19	42	54	10 ♐	6	5	17	28	7	16	1	22	46	21	7	4	53
13	20	41	23	24	13	5	12	28	15	15	59	23	23	22	20	6	35
14	21	39	56	8 ♑	27	4	47	28	22	15	57	24	0	23	33	8	18
15	22	38	30	22	45	4	5	28	30	15	55	24	37	24	46	10	3
16	23	37	6	7 ♒	3	3	8	28	37	15	53	25	13	25	59	11	50
17	24	35	44	21	17	1	59	28	45	15	50	25	50	27	12	13	39
B	25	34	24	5 ♓	28	0	43	28	52	15	48	26	26	28	25	15	30
19	26	33	6	19	27	0	S.34	29	0	15	45	27	2	29	38	17	22
20	27	31	51	3 ♈	10	1	48	29	8	15	43	27	38	0 ♍	51	19	13
21	28	30	37	16	36	2	54	29	15	15	40	28	14	2	5	21	4
22	29	29	26	29	43	3	50	29	23	15	36	28	50	3	18	22	55
23	♎	28	16	12 ♉	31	4	32	29	31	15	32	29	26	4	32	24	45
24	1	27	8	25	5	5	0	29	38	15	28	0 ♌	1	5	46	26	35
B	2	26	1	7 ♊	16	5	14	29	46	15	24	0	37	7	0	28	24
26	3	24	57	19	19	5	14	29	53	15	19	1	12	8	14	0 ♎	12
27	4	23	55	1 ♋	15	5	0	0 ♎	0	15	15	1	48	9	27	2	0
28	5	22	55	13	7	4	33	0	8	15	11	2	23	10	41	3	47
29	6	21	57	25	1	3	55	0	15	15	6	2	58	11	55	5	34
30	7	21	1	7 ♌	1	3	6	0	22	15	2	3	33	13	9	7	20

Days	Day decreaſ		Length of Day		Helioc. Plac. ♄		Helioc. Plac ♃		Helioc. Plac. ♂		Helioc. Plac. ⊖		Helioc. Plac. ♀		Helioc Plac. ☿		Saturn ſets.	
1	3	3	13	31	28 ♍	39	5 ♉	20	4 ♊	24	9 ♓	1	21 ♊	17	1 ♉	18	7	A.28
7	3	25	13	9	28	51	5	53	17	27	14	51	0 ♋	59	7 ♊	47	7	7
13	3	49	12	45	29	3	6	25	20	28	20	41	10	42	15 ♋	18	6	46
19	4	13	12	21	29	16	6	58	23	27	26	33	20	25	19 ♌	11	6	25
25	4	30	11	57	29	29	7	31	26	24	2 ♈	26	0 ♌	10	17 ♍	29	riſes.	

SECTION XVII.

Some general Obſervations on the SOLAR SYSTEM *and* PLANETARY WORLDS.

BY an attentive conſideration of this ſhort ſurvey of the Solar Syſtem, we learn, that the Planets with their attendants are much of the ſame nature with our Earth, and deſtined for the ſame purpoſes; for they are ſolid and opaque Globes, capable of ſupporting animals and vegetables, ſome of them are greater, ſome leſs, and ſome much about the ſize of the Earth; they all circulate round the Sun as our Earth does, in a ſhorter or longer time, according to their diſtances, which muſt render them their regular returns of Summer and Winter, Spring and Autumn. They have warmer and colder climates, as the various productions of our Earth require; and in ſuch as afford any poſſibility of diſcovering it, we perceive a regular rotation round their axis like that of the Earth, making day and night alternately, which is neceſſary for labour, reſt, and vegetation, and expoſes all parts of their ſurfaces to the influence of the Sun's rays. Such of the Planets as being furtheſt from the Sun, and enjoy leaſt of his light, have that deficiency compenſated by ſeveral leſſer Planets or Moons, which continually accompany and revolve round them, as our Moon does round us. The remoteſt of them (*i. e. Saturn*) is furniſhed with a broad ring encompaſſing him, which like a Lucid Zone in the Heavens, reflects the Sun's light very copiouſly upon the Planet, ſo that if they have the Sun's light fainter by day than we, they have an addition made to it morning and evening by ſeveral Moons, and a greater light in the night, which demonſtrates the impartiality of Providence. The Moon being nearer to us than any other of the celeſtial bodies, enables us to diſcover on its ſurface a ſtrong reſemblance of the Earth, for by the aſſiſtance of a Teleſcope, Seas and Lakes, Mountains, Vallies, and deep Cavities are obſerved in it. Theſe ſimilarities leave no room to doubt that not only our Moon, but all the other Planets and Moons in the Syſtem are of like nature with our Earth, and deſigned as commodious habitations for creatures endowed with capacities of knowing, obeying, and adoring their beneficent Creator; ſince the numberleſs fixed Stars are prodigious ſpheres of fire like our Sun, and at inconceivable diſtances from each other as well as from us. Is it not reaſonable to conclude, they are made for the ſame purpoſes that the Sun is, each to beſtow light, heat, and vegetation on a certain ordained number of inhabited Planets, kept by gravitation within the ſphere of its activity by the Omnipotent, for 'twas HE *made the* WORLDS, Heb. i. ver. 2. *and telleth the number of the Stars, he calleth them all by their names,* Pſalm cxlvii. ver. 4. What an auguſt, what an amazing conception, if human imagination can conceive it, does this afford of the works of the CREATOR! Thouſands of thouſands of Suns extending without end beyond each other all around, and at immenſe diſtances ranged in the moſt beauteous order, accompanied with ten thouſand times ten thouſand Worlds ſelf-ballanced all in rapid motion, yet calm and ſmooth, regular and harmonious, invariably keeping thoſe paths which their Great Law giver preſcribed them, and theſe Worlds peopled with myriads of intelligent beings, all candidates for Heaven, and capable of endleſs progreſſion in perfection and felicity! If ſo much power, wiſdom, goodneſs, and magnificence is diſplayed in the material part of the Creation, which is perhaps but a ſmall part of the Univerſe, how great, how wiſe, how good muſt HE be, who made and guides the whole.

The ſpacious Firmament on high,
With all the blue ætherial Sky,
And ſpangling Heavens, a ſhining frame,
Their great original proclaim:
Th' unwearied Sun, from day to day,
Does his Creator's pow'r diſplay,
And publiſhes to ev'ry land
The work of an Almighty hand.

II.

Soon as the ev'ning ſhades prevail,
The Moon takes up the wond'rous tale,
And nightly to the liſt'ning Earth
Repeats the ſtory of her birth;
Whilſt all the Stars that round her burn,
And all the Planets in their turn,
Confirm the tidings as they roll,
And ſpread the truth from Pole to Pole.

III.

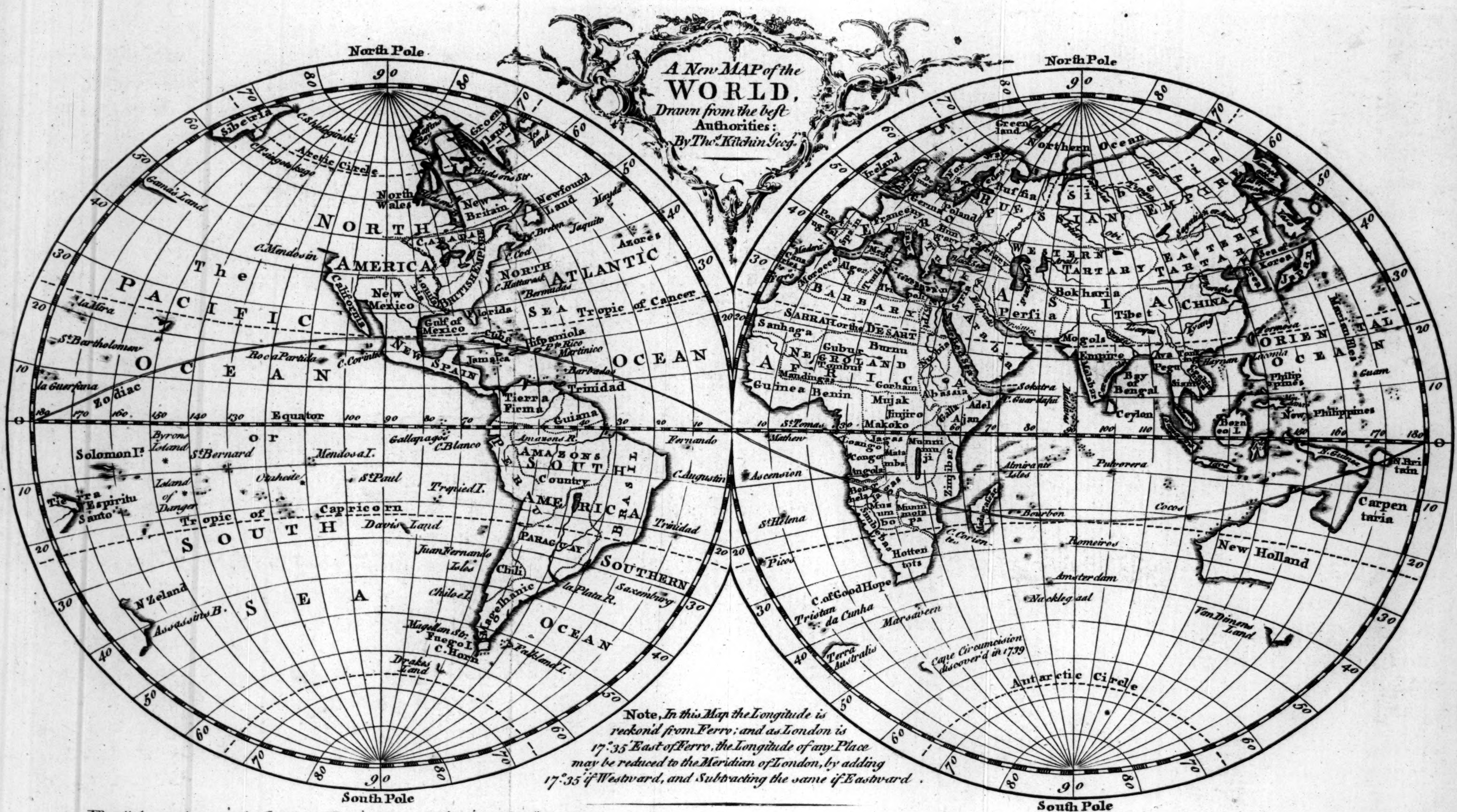
What though, in ſolemn ſilence, all
Move round the dark terreſtrial ball?
What though no real voice nor ſound
Amid their radiant Orbs be found?
In reaſon's ear they all rejoice,
And utter forth a glorious voice,
For ever ſinging as they ſhine,
" The Hand that made us is Divine." **ADDISON.**

SECTION XVIII.

The EARTH's *Motion deſcribed.*

HITHERTO we have treated of the Earth chiefly as our habitation, and ſhewn the infinite wiſdom and goodneſs of the *great Author of Nature* in fertilizing and beautifying the external ſurface of this terraqueous Nurſery of man, and accommodated proper animals thereon for his uſe and food, as alſo ſalutary vegetables of ſeveral kinds for our health and ſuſtenance. We are now to conſider this Terreſtrial Globe as a PLANET; the ſyſtem of the Univerſe has already been deſcribed, wherein it hath been ſhewn that the Sun is fixed in the center, and that ſix planetary Globes revolve in different Orbits round that immenſe body of light.

The



A New MAP of the WORLD,
Drawn from the best Authorities:
By Thos. Kitchin Geog.

Note, *In this Map the Longitude is reckon'd from Ferro; and as London is 17°.35' East of Ferro, the Longitude of any Place may be reduced to the Meridian of London, by adding 17°.35' if Westward, and Subtracting the same if Eastward.*

NB. all those places in the Southern Hemisphere mark'd with a Star are the New Discoveries made by Mr. Banks & Dr. Solander in the Years 1769 1770 & 1771.*

Price 1s. 6d.

The Earth we inhabit is one of thoſe ſix revolving Planets; each of the Planets move in an Orbit round the Sun, and ſo does the Earth that we inhabit, and makes one of thoſe great revolutions in 365 days and ſix hours, which conſtitutes our year, and it is by this progreſſive or annual motion of the Earth that our year is meaſured. Beſides revolving round the Sun, the *Planets* are known and ſeen to have another motion, that is, they turn round upon their * Axis, by which wonderful contrivance each part of the Planet is by rotation preſented to the Sun, and receives the ſalutary benefit of his benign influence. It is the ſame with our Earth, for in the ſpace of 24 hours it makes one compleat revolution on its Axis, and every inhabitant upon the face of the Earth, by this motion enjoys within the 24 hours nearly an equal portion of the Sun's light; during the time this motion brings any inhabitant of the Earth towards the Sun, it is called Day, and when turned from the Sun, it is called Night; thus in 24 hours is day and night alternately occaſioned all over the world. This motion of the Earth is from Weſt to Eaſt, or according to the Signs of the Ecliptic, in which they follow one another. This real motion of the Earth from Weſt to Eaſt, occaſions an apparent motion of all the heavenly bodies in a contrary direction, or from Eaſt to Weſt, for the Sun and fixed Stars appear to us to riſe, to paſs over our Earth, and to ſet. The truth is, we are carried on ourſelves by the motion of the Earth, and thus our own motion makes us think that the Sun and Stars have a motion, which are abſolute fixed bodies. Thus when we ride in a coach, and look out of the window, all the trees, &c. ſeem to move and paſs by us, when it is our own motion in the coach that cauſes thoſe appearances. Thus, ſuppoſe ourſelves in a cabbin of a ſhip, which in a fine calm gentle glides down the river, we look out of the cabbin window, the ſteeples, hills, and all objects on land ſeem to move and receed from us; ſhut the cabbin window and turn your eye from any external object, and although the veſſel glides ſwiftly on, yet every thing within will appear ſtill and at reſt in the cabbin; for our partaking of the ſame motion occaſions all things about us to appear at perfect reſt, and thus it is, although our Earth moves very ſwiſt, we ourſelves partake of the ſame motion, and therefore cannot perceive the on the Earth to move.

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* Somewhat like a coach-wheel runing round a circle, for the wheel not only runs round the circle, but likewiſe turns upon its own axis, and thus the Earth moves in its Orbit round the Sun in a year, and revolves upon its own axis at the ſame time, at the rate of 900 miles per hour.

From what has been ſaid, perhaps the Reader may be fully ſatisfied of the reality of the Earth's motion, but yet would be glad, as there are ſome objections to have them anſwered.—If a ſtone is thrown directly up it will be obſerved to fall down again juſt at your feet; but if the Earth whirld with a rapid motion from Weſt to Eaſt, the part from which the ſtone was thrown up, muſt be carried a conſiderable way eaſtward, while the ſtone is in the air, ſo that it would fall to the Weſt of the part from whence it was caſt up. A ſtone dropped from the top of a high tower would not fall juſt at the foot but to the Weſt of it; and birds, when they fly to the Eaſt, would be left behind towards the Weſt, or if they fly towards the Weſt would be forwarded; but on the contrary, they perform their flight over an equal diſtance of the Earth, in an equal time, both ways indifferently, which could not be, if the Earth moves ſo ſwiftly below them. It may alſo be obſerved, if you run with ſome violence, a breeze always meets you in the face, though there be no air ſtirring; but you think there ought conſtantly to be a ſtrong wind from the Eaſt, while the place we are in is carried from the Weſt to the Eaſt with ſuch force. In order to remove ſome of theſe difficulties, it muſt be obſerved, that a body, which is contained in a thing, partakes of the motion of that thing which contains it. If a ſhip be under ſail, and move ſmoothly along, the ſeveral motions of the people below deck, or walking above, are performed in the ſame manner as if the ſhip ſtood ſtill. It is obſervable, that flies in a ſhip continue their flight indifferently towards all parts, and are never driven together towards the ſide of the cabbin, or next the prow, as if wearied with following the ſwift motion of the ſhip. This inſtance may ſerve to give ſome ſort of an idea of the flight of birds, which partake of the motion of the Earth, even while they are in the air, in the ſame manner as the flies do in the ſhip; for the air partakes of the ſame motion with the Earth; ſo that birds fly up and down in it, as if the Earth or it had no ſuch motion. And ſince the Air partakes of the ſame motion with the Earth, there cannot be a conſtant breeze from the Eaſt, mentioned before, ſweeping over the plains. Nor by any reaſon of the ſhip's motion, can a perſon make a longer leap towards the ſtern than the head, notwithſtanding that whilſt he is up in the Air, the ſloor under his feet runs a contrary way to the leap. The ſmoke of incenſe will hang like a Cloud, moving indifferently, this way or that way, without any inclination to one ſide of the ſhip more than the other. A bottle of water being hung up to empty itſelf, drop by drop, into another bottle placed beneath, with a narrow neck, the drops will all fall into the bottle, and not one towards the ſtern, though the ſhip ſhall have run many inches whilſt the drop was in the air. It is indeed amazing, that our bodies ſhould be conſtantly hurried along with ſuch prodigious impetuoſity; and yet that we ſhould be as little incommoded by it, and even inſenſible of it, as if nothing ſtirred in Nature! The liquor in the cup is not ſhaken, the infant that has but juſt ſtrength to ſtand upright is not moleſted, and every thing is as ſtable and firm, as if our Earth reſted on ſome eternal foundation! 'Twas God, the *Almighty firſt mover*, occaſioned this motion, and has hitherto preſerved it without dimunition. Thus the bare motions of the Earth alone is a proof of a Divine power therein concerned; if to this we add the *convenience* and prodigious uſe of this motion, not only to our own Earth, but to all the reſpective Globes, we ſhall find that an infinitely *wiſe* and *kind*, as well as *omnipotent Being*, was the orderer thereof, for were thoſe Globes always to ſtand ſtill, that owe their light and heat to the Sun; in this caſe one half of them would be dazzled and parched with everlaſting day, whilſt the other would be involved in everlaſting night and darkneſs, and what the conſequences would be, we may beſt judge from what would befal our own Globe without the kindly alterations of day and night; and that is, that at leaſt a very conſiderable part of it would ſcarce be habitable, it would neither agree to the ſtate of man or any other animals, nor to that of vegetables, or indeed any other creature, for one half of the Globe would be burning up, at leaſt too much drying, and exhauſted with the beams of the Sun, whilſt the other would be immerged in, and deadened with too long night; and in ſuch a caſe, how could the great works of Nature, ſo ſerviceable to the world, be performed? How for inſtance could the Vapours be raiſed to ſupply the Earth with cooling clouds and fertile ſhowers? How could the winds be excited to fan the Atmoſphere with their pleaſant and healthful gales? How could the tides be produced, which by their conſtant agitations keep the waters ſweet and clean for the preſervation of fiſh and benefit of mankind; and as the courſe and functions of Nature would be thus affected, ſo would the ſtate of the creatures be no leſs, for how could thoſe of the vegetable kingdom be animated and excited by the kindly heat of the day, and then again tempered and invigorated by the no leſs kindly dews and influences of the night? How could men and all other animals diſpatch their buſineſs, gather their food, and perform all the various labours and offices of the day, and then recruit and repoſe themſelves with needful reſt, ſleep, and due perſpiration, and whatever elſe may be owing to the ſalutiferous influences of the night and abſence of the Sun? Well might the royal Pſalmiſt ſay, *In wiſdom, O Lord, hath thou ordained them all.*

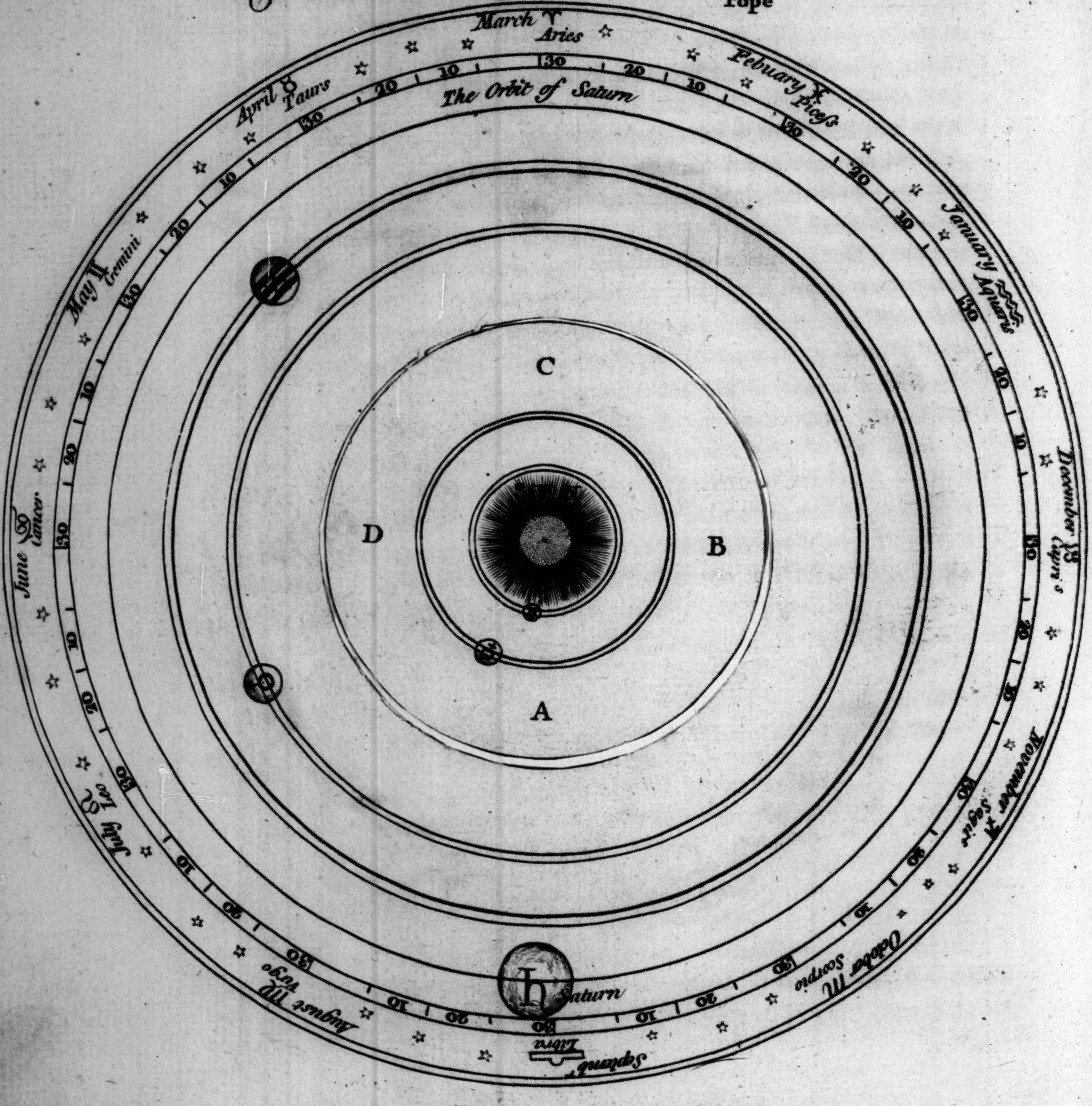
Theſe, and ten thouſand as great inconveniences as theſe, would be the certain events of the want of this diurnal motion of our Globe, and as the reſt of the Globes have their ſhares in the like motion, ſo we may very reaſonably imagine that it is no leſs uſeful and beneficial to them than it is to us, and that the inconveniences of the want of it would be as great: Thus we ſee all things wiſely ordered for our convenience, comfort, and felicity; *the Lord is good to all, and his tender mercies are over all his Works.* Pſalm cxl. ver, 9. Let theſe reſearches therefore inſpire us with gratitude, and incline us *to act well our parts,* and thereby ſhew our duty and veneration to that GREAT, that BENEVOLENT AUTHOR of every good.

SECTION

The ORRERY

Go wondrous Creature! mount where Science Guides
Go Measure Earth, Weigh Air & State the tides
Teach us what Course the Various Planets run
Correct Old Time & Regulate the Sun

Pope



♄ ...... *Saturn*
♃ ...... *Jupiter*
♂ ...... *Mars*

⊕ ...... *Earth & Moon*
♀ ...... *Venus*
☿ ...... *Mercury*

SECTION XIX.

Deſcription of the ORRERY.

THAT curious machine, generally known by the name of the *Orrery* was, with infinite aſſiduity and labour, invented by degrees, and made in its utmoſt perfection firſt by Mr. *Rowley* for King *George* the Firſt, after which the Earl of *Orrery* beſpoke another, and patronized the maker, and from him it's ſuppoſed that it had its name. Others will have it derived from a Greek word of the ſame ſound, which ſignifies *to ſee*; becauſe in this machine we ſee all the motions of the heavenly bodies performed in the ſame manner as they are in Nature itſelf. The machinery in the Orrery is ſo very numerous and complicated, as renders it impoſſible to give the reader a clear and familiar deſcription thereof, unleſs the Orrery was before him: but their great price * occaſions them to be in very few hands. I have, therefore, invented and preſumed to ſubſtitute the oppoſite inſtrument, which will not only afford the reader an idea of the Orrery, but will alſo enable him to perform ſeveral entertaining problems nearly as accurately as on the real Orrery.

This Orrery before us is a moveable inſtrument, calculated to ſhew the revolutions and different motions of our *Earth* and *Moon*, with the excurſions of the Planets, together with the ſeveral orbits of the heavenly bodies, their conjunctions, oppoſitions, the time and place of their being viſible and inviſible, with the general phænomena of the celeſtial bodies.

A bare inſpection of the Orrery will evince, that the outward circle repreſents the ſtarry canopy of the heavens. Thoſe various characters contained in that circle are the Signs of the Zodiac, ♈ *Aries*, ♉ *Taurus*, ♊ *Gemini*, &c. Beneath theſe conſtellations revolve all our ſyſtem of Planets in their reſpective orbits. That circle near the Zodiac is the orbit of our floweſt and moſt remote Planet ♄ *Saturn*; next unto *Saturn* is ♃ *Jupiter's* orb; ♂ *Mars* revolves in the following circle; and then we have our ⊖ *Earth*, with its conſtant attendant the ☽ *Moon*; next we have the track of ♀ *Venus*; then ☿ *Mercury*; laſtly fixed in the center is that great luminary the Sun. All theſe Planets are immenſe opaque globes, the whole of them circulating round, warmed and enlightened by the ſame Sun that warms, chears, and enlightens us. *Infinite Wiſdom* has thought proper to diſpoſe this great fountain of light in ſo advantageous a manner, that all thoſe *revolving Worlds* enjoy his benefit, and are, like us, favoured with his bright influence.

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* That made for King George the Firſt coſt 1000 guineas. I have lately uſed one that coſt 1300 guineas; and even the ſmalleſt inferior Orreries are at a very high value, on account of the multiplicity of their machinery, &c.

Having thus defined the figure of the Orrery, we ſhall proceed to its uſe:—And in

PROBLEM I.

We ſhall explain by this Inſtrument, Why the Sun, being a fixed Body, appears to paſs through all the Signs of the Zodiac in twelve Months, or one Year; and it will demonſtrate that this Phænomenon is occaſioned by the annual Mo- of the Earth round the Sun.

The Sun is the principal light of that ſyſtem of the world wherein we are placed.

The *Phænomena* of the *Sun*, which are vulgarly aſcribed to its ſeeming *annual* motion, may be ſolved by the *annual* motion of the *Earth*. In order to make this evident, it is firſt to be ſhewn, that the *annual* motion of the *Earth* will cauſe the Sun to appear to us, as if that luminary had ſuch an *annnal* motion, though in reality it hath no ſuch motion; and this is illuſtrated by the Orrery, where the *Sun* is in the center. That circle, in which the *Earth* is placed, is called the *Earth*'s *orbit*, or that circular line which the centre of the *Earth* deſcribes by its *yearly* or *annual motion* round the *Sun*. The outermoſt circle repreſents the *Zodiac* diſtinguiſhed into twelve parts or Signs, as ♈, ♉, ♊, ♋, &c. Now, ſuppoſing the Earth to be at A, to a ſpectator on the *Earth*, looking towards the *Sun*, it would appear to be in ♈ *Aries*, which is oppoſite to the *Earth* *. We ſee in the outermoſt circle the character ♈ with *Aries* wrote under; as alſo the month *Marcb*, which implies the *Sun* is ſeen under this Sign in *March*, as it really is. By examining the *Sun*'s place in the *Ephemeris* for the latter end of *March*, you will find the *Sun* deſcribed in ♈, as it here appears. Move the *Earth* on in its orbit to B; the *Sun* will then appear under ♋ *Cancer* in *June*, which is its true place, and ſeems to have moved from ♈ to this Sign ♋, when it hath not ſtirred, but the real motion of the *Eartb* from A to B has cauſed the apparent motion of the *Sun* from C to D, continues to move the *Earth* on in its orbit * from B to C. In this ſituation a ſpectator on the *Earth* would ſee the *Sun* in ♎ *Libra*, and *September* wrote over it, denoting that the Sun is ſeen in the Sign *Libra* in *September*, which you will obſerve is ſo mentioned in the *Ephemeris*; for, by examining that Diary of the Planets motions (which you'll find inſerted a few leaves back) you will obſerve (letting the *Earth* reſt at C) not only the exact place of the *Earth* and *Sun*, but of all the Planets for the 23d of *September*, 1774. Move the *Earth* on to D, and you will have the *Sun* in ♑ *Capricornus*, as it appears in the month of *December*. Laſtly, continue the *Earth* on to A, and you ſee the *Sun* again in ♈ *Aries*. Thus it is plainly demonſtrated to be the real motion of the *Earth*, which cauſes the *Sun* thus to appear in all the different Signs of the Zodiac. Cuſtom has taught us to ſay the Sun *is in Aries*, when it is between us and *Aries* (and ſo of any other Sign)

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* If the Earth was viewed from the Sun as ſhe revolves in her orbit, ſhe (i. e. the Earth) would ſeem to paſs (as a ſmall Planet) thro' the heavens, deſcribing that circle amongſt the

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the fixed Stars, which we call the ZODIAC. This circle Aſtronomers have divided into twelve equal parts, correſponding to the twelve months of the year, and have ſuppoſed each part covered with an image or picture of ſome living creature, and called that ſpace by the name or ſign of the image depictured therein. The names and characters of the twelve Signs are ♈ Aries, ♉ Taurus, ♊ Gemini, &c. (ſee Section XV.) When the Earth moves round ber orbit, and comes to any of theſe pictures, ſhe is ſaid to be in that Sign, which the picture expreſſes, and as the Earth like the reſt of the Planets revolves from Weſt to Eaſt, the Sun will appear to have an annual motion the ſame way, and in the ſame track, but ſtill in the oppoſite point; for, when the Earth is in that part marked ♈ Aries, the Sun will be in that part marked ♎ Libra; and ſo of any other, as may be ſeen in the Earth's orbit.

* The line that the Earth, or any Planet or Comet deſcribes round the Sun is called its *Orbit*, and the motion of all tbe Planets in their orbits is from the *Weſt* by the South to *Eaſtward*; this is called their annual motion, and *motus ſecundus*. We take the orbit of our Earth for a ſtandard, and compute the inclination of the other orbits from thence.

if we would ſpeak properly, agreeable to the natural cauſe of this and ſuch like *phænomena*, we ſhould ſay that the *Earth is then in Libra*; for the *Earth* in its real motion is always in that point of the Zodiac oppoſite to which the Sun appears to be. Thus the Orrery clearly explains, that the annual motion of the *Earth* under the Zodiac will make the Sun appear to us as if it had ſuch an *annual* motion; and proves, that the Moon, with her whole orbit, accompanies the Earth in its annual motion round the Sun.

The Orrery having thus demonſtrated the Earth's motion round the Sun; we ſhall proceed to

PROBLEM II.

In which is required to explain, by the Orrery, what occaſions a Solar *or* Lunar *Eclipſe.*

A SOLAR Eclipſe is occaſioned by the *Moon* interpoſing itſelf between us and the Sun, and thereby depriving us of ſome * part of the Sun's light; which can never happen but at the time of *New Moon*, for in that aſpect the Moon is almoſt immediately between our eye and the Sun. By attention to the Orrery, we ſhall obſerve the Moon is a conſtant attendant upon us, (altho' ſometimes inviſible) and moves in a ſmall orbit round the Earth; that is, between the Earth and the Sun, conſequently muſt ſometimes be between us and the Sun, and therefore eclipſe that bright luminary. To explain this by the Orrery; bring the Earth and Moon's orbit (which always follows the Earth) down to A; then turn the orbit of the Moon, till the figure of the Moon is directly between the Earth and the Sun; and bring the letter E upon the Earth, which ſignifies England, exact under the Moon; thus you have the *Earth*, *Moon*, and *Sun* in a ſtrait line, which is the real ſituation of Nature in an eclipſe;

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* The Sun is much larger than the Moon; therefore an eclipſe of the Sun muſt be always partial; that is, ſome parts of the Earth only will be deprived of his light, while other countries at the ſame inſtant enjoy his full luſtre. Thus there will be a Solar Eclipſe on the 12th day of March 1774, near 10 o'clock in the forenoon, but will be inviſible to us in England; as the ſhadow of the Moon will not cover that part of the Sun oppoſed to us, therefore we ſhall not obſerve this Eclipſe. But in more ſouthern ſituations, i. e. the ſouth-eaſt part of Africa, the Sun will appear almoſt totally eclipſed, and that at their mid-day.

and a perſon at E under the Moon, would, by this interpoſition of the Lunar orb, be deprived of the Sun's rays, and conſequently there would be a duſky gloom on that part of the Earth; but yet a ſpectator at C on the Earth, which means China, would be ſomewhat (by the diurnal motion of the Earth) turned away from the *Moon*; and therefore a part of the Sun towards them would ſhine very bright and conſpicuous, altho' at the ſame inſtant *we* are ſhadowed by the Eclipſe.

A *Lunar Eclipſe* is occaſioned by the interpoſition of the *Earth* between the Sun and Moon. For the Moon, when ſhe is eclipſed, having no light of her own, ſuffers a real diminution of her borrowed light, by the Earth coming between her and the Sun, and ſtopping the rays of the Sun in their paſſage towards the Moon. *To explain this by the Orrery*, let the Earth remain as it is, bring the Moon in her orbit round to the oppoſite point to where ſhe before was (for a Lunar Eclipſe can never happen but at a *full Moon* †, at which time the Moon is always oppoſite the Sun) therefore, having placed the Moon oppoſite to where ſhe before was, you will again have the *Sun*, *Earth*, and *Moon* in a ſtrait line; and thus will the body of the Earth ſhade the Sun from the Moon, that is, the ſhadow of the Earth will be reflected upon the Moon's ſurface, and the Earth being larger than the Moon, frequently occaſions the Lunar orb to be totally eclipſed.

Thus is demonſtrated by the Orrery the nature of Eclipſes, and is alſo ſhewn, that not only the Moon, but its whole orbit conſtantly attends and follows the Earth, both in its diurnal and annual motion round the Sun.

The uſe of Eclipſes in Chronology is to determine exactly the time of any paſt events; for there are ſo many particulars obſervable in every Eclipſe, *viz.* time of the day, place where viſible, quantity of the Eclipſe, &c. that 'tis hardly poſſible two Eclipſes ſhould happen within the compaſs of many ages exactly alike in all circumſtances. If therefore any paſt Eclipſes be recorded in hiſtory with ſome of theſe circumſtances, it may eaſily be computed how long ago it happened, by tables of the motions of the Sun and Moon.

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* It is known, that the Moon travels in its orbit round the Earth in one month; therefore, according to this doctrine, it would to the unſkilful appear as if two Eclipſes were to happen each month. But this is prevented by a particular obliquity of the Moon's orbit, which will hereafter be explained. The number of Eclipſes of both luminaries in one year cannot be leſs than two nor more than eight. The moſt uſual number is four.

PROBLEM III.

Required, Why at various times of the year we ſee the heavens decorated with an entire different collection of ſtars?

THIS phænomenon is occaſioned by the Earth's progreſſive or annual motion round its orbit. The rotation of the Earth upon its axis occaſions day and night. Its annual motion round the Sun conſtitutes our year; and while the Earth is thus traverſing his courſe under the vaſt concave of fixed Stars, we are gradually carried under the different conſtellations. In September the Earth is conveyed to *Aries*; to *Taurus* in October, and to *Gemini* in November, *per contra* to thoſe Signs in which the Sun is: and thus, in the ſpace of twelve months or one year, we are carried along with the Earth round its orbit under all the twelve Signs, till we come again to *Aries*, which compleats our year.

From hence it is evident, that at night, when the Earth is turned from the Sun, we ſhall in ſucceſſion have an opportunity of viewing from time to time all the Stars in the Zodiac; and conſequently a different conſtellation will preſent itſelf every month.

Thus the *Pleiades* are not viſible in the ſummer: but in the winter the Earth, in its annual courſe, is got between the Sun and the *Pleiades* (for the fixed Stars are far beyond the limits of Saturn, and conſequently an immenſe diſtance without the Earth's orbit). When, therefore, the Earth has got between the Sun and *theſe Stars*, they become obſerveable * in the night,

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* All the phænomena in the heavens appear to us every moment, not in the places where they now are, but where they were ſome time ſince; which interval of time is greater the more diſtant the phænomenon is, *e. g.* the Sun appears in the meridian, when he has paſſed it ſeven minutes. A ſtar now appears in the Zenith, whereas thoſe rays, which this moment enter our eyes, and ſhew us they were emitted from the ſtar ſome days, perhaps weeks ago, which verifies this paradox, that if the ſtars were this moment extinguiſhed, we might continue ſtill to ſee them for ſome weeks. The velocity of the rays of light, computed *per præcedentem*, is ſuch, that it paſſes through a ſemi-diameter of the Earth's orbit in about ſeven minutes.

night as not being intercepted from our ſight by the Sun's rays, and in this manner they appear during the whole Winter, only they ſeem to get more *weſterly* every night, as the Earth moves gradually by them to the *Eaſt*. To make this ſtill more clear, place the Earth in the Orrery, between the Sun and any of the Signs or fixed Stars, that ſide of the Earth towards the Sun will be day, and that towards the Sign or Star will be night: it follows that at night we are turned towards this Star, (we'll ſuppoſe the *Pleiades* in *Taurus*) which then muſt be conſpicuous to us; as the ſpring approaches the Earth withdraws itſelf from between the Sun and the *Pleiades*, till at length the Earth by its progreſſive motion gets the Sun between it and the Stars, which then lie hid behind the ſolar rays; after the ſame manner, while the Earth performs its annual tract, the Sun, which always ſeems to move the contrary way, darkens, by his uncontroulable ſplendor, the other conſtellations ſucceſſively, but the Stars oppoſite to thoſe Stars which the Sun hides, are at night preſented to our view.

Thus from beholding the Heavens in the night time, you may diſcover the relative motion between the Sun and the Earth, and determine the real motion of the Earth by the arguments and Problems before given; therefore all the Stars muſt come in view ſucceſſively to that part of the Earth turned from the Sun (*i. e.* night time) according as the Earth advances in its orbit.

For Example. Bring the Earth to C under the ſign ♈ *Aries*, which is the ſituation of the Earth the latter end of *September*, * and at night, if clear, will be ſeen all thoſe Stars which compoſe the conſtellation called *Aries*. Move the Earth on in its orbit to ♉ *Taurus*, where the Earth is the latter end of *October*; here we ſhall obſerve a freſh collection of Stars, and ſoon in the evening after Sun ſet we ſee the *Pleiades* or Seven Stars ariſing into our Hemiſphere, and ſoon after ♉ *Taurus* or the Bull appears; the head of this conſtellation is very conſpicuous in the Heavens, reſembling the letter V, having an exceeding bright Star in it, called *Aldebaran*, or the Bull's eye, and is one of thoſe Stars of the firſt magnitude. It will be ſeen riſing a little North-eaſt, about ſeven o'clock in the evening, but the *Pleiades* or Seven Stars will be ſeen immediately after Sun ſet. Move the Earth on to *Gemini* ♊, the Sun will then be in ♐ *Sagittarius*, which is both their places the latter end of *November*; when about two hours after Sun ſet, we ſhall perceive thoſe Stars ariſe North-eaſt, which makes the Sign *Gemini*. Move the Earth on to ♋ *Cancer*, where the Earth is in *December*; here you will ſee immediately after Sun ſet, a bright Star called *Mencar*, riſing in the Eaſt, and about two hours after will be ſeen riſing all that Sign called *Cancer*. Move the Earth on in the Orrery to ♌ *Leo*, the Earth's place in *January*; then about two hours after Sun ſet will be ſeen in the North-eaſt part of the Heavens all thoſe Stars which conſtitute the conſtellation called *Leo*; amongſt which is a large bright Star of the firſt magnitude called *Cor Leo*, and toward the South-eaſt will be ſeen riſing about ſeven in the evening *Sirius*, the largeſt Star in our Hemiſphere, generally called the *Dog Star*, which is inviſible in *July*, as it then riſeth and ſetteth with the Sun, this time is therefore called the *Dog Days*. More Southerly a little above this Star will be ſeen *Orion*, which is mentioned in *Job*, Chap. vii. ver. 9. and in ſeveral other places of the Scriptures, *who maketh Arcturus*, *Orion*, and *Pleiades*, *and the chambers of the South*; and thus by continuing to move the Earth round its Orbit the Orrery will demonſtrate, that by this annual motion of the Earth, we are at different times of the year preſented with the ſight of all the different conſtellations which compoſe the twelve Signs of the Zodiac, and this ſolution will naturally lead us to

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* Was an eye placed in the Sun in *September*, it would obſerve the Earth in ♈ *Aries*; but a ſpectator on the Earth at this time would obſerve the Sun in ♎ *Libra*, which is plainly ſeen in the Orrery.

PROBLEM IV.

Wherein is demanded why the PLANETS *are ſometimes viſible and at other times inviſible.*

WHEN the Planets in their excurſions approach near the Sun, they are by the ſuperior * light of that luminary, rendered inviſible to us. For

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* In the ſtrong rays of the Sun the flame of a candle is inviſible, as all leſſer lights are over-powered by a greater; thus all the Stars ſhine as bright in the middle of the day as in the night; but their light, during day, is rendered inviſible by the Sun's ſuperior brightneſs.

Example.—Bring the Earth in the Orrery to C, that is under the Sign ♈ *Aries*, the Planet *Saturn* being in the oppoſite Sign *Libra*, and behind the Sun, muſt conſequently be inviſible; therefore in *September* 1774, the Planet *Saturn* will be inviſible: we ſay *September*, becauſe we know in the latter end of that month the Sun is always in *Libra*, and *Saturn* being in the ſame Sign, muſt by the powerful rays of the Sun be hid from us; but if we move the Earth on to D, where the Earth will be in *December*, then ſhall we ſee *Saturn* juſt before this part of the Globe which we inhabit, is turned to the Sun, or in more plain words, *Saturn* at this time of the year will be viſible only a ſmall time before Sun riſe. But moving the Earth on to A, where the Earth will be the latter end of *March* 1775, the Orrery will ſhew that in the day E, (on the Earth, which ſignifies *England*) will be turned towards the Sun, and at night towards *Saturn*, occaſioned by the ſituation of the Earth between both, and therefore the Planet *Saturn*, which is inviſible to us during this Autumn of 1774, will become viſible to us in the following Spring, in the year 1775.

By examining the Ephemeris you will find that *Jupiter*, in *March* 1774, will be in *Aries*, and the Earth will be in the oppoſite Sign *Libra*, conſequently the Sun will be between the Earth and *Jupiter*, and therefore render *Jupiter* inviſible. But in *November* the Earth, by moving on in its Orbit will have got into 15 degrees of *Taurus*, therefore bring the Earth in the Orrery, and place it exact between C and D, then will the Orrery ſhew you that the Earth by its annual motion has now interpoſed itſelf between the Sun and *Jupiter*; therefore that beautiful Planet *Jupiter* will, during *October* and *November* 1774, be viſible every fine night to all the inhabitants of *Great Britain*.

Thus the Orrery clearly demonſtrates that it is the Earth's progreſſive motion which occaſion the Planets to be either *viſible* or *inviſible*, for when the Earth in traverſing its Orbit has got in the oppoſite Sign to any Planet, the Sun will then be between that Planet and the Earth, and conſequently by the brightneſs of his rays render that Planet inviſible to any ſpectator on the Earth; but the Earth continuing to travel on by the quickneſs of its motion, overtakes the ſlower Planets, and thus interpoſes or gets between the Sun and Planet, and at night when the Earth is turned from the Sun, the Planet will be viſible and very conſpicuous.

PROBLEM V.

Required why ſome nations on the Earth ſee the Sun riſe before others, and why it happens to be noon or mid-day with ſome, while it is mid-night with others.

To explain this we muſt aſſiſt our ideas by ſuppoſing a bowl to be trundling upon a Green, this bowl would have two motions, one in running towards the jack, at the ſame time often turns round itſelf, inſomuch that the part of this bowl which is above, deſcends below, and that which was below aſcends above. The Earth performs juſt the ſame thing; during the time ſhe is advancing in her circle round the Sun, ſhe turns round herſelf, or as Aſtronomers term it, upon her Axis in twenty-four hours, ſo that in twenty-four hours, nearly every part of the Earth loſes ſight of the Sun, and again recovers it, and in proportion as it turns or goes towards that part where the Sun is, it appears as if the *Sun riſes*, and when it begins to remove itſelf from the Sun in continuing its motion, it ſeems that the *Sun ſets*. *

For Example. Bring the Earth in the Orrery to A (in its orbit) which is the Earth's ſituation in *March*; then take notice of thoſe four letters which you will ſee on the Earth, *viz.* E. C. A. S.—E repreſents where *England* is ſituated; S the *Great South Seas*; A *Antipodes*, or thoſe people that are oppoſite to us; C for *China*.—Now *day* is occaſioned at any of thoſe places which are turned *towards* the Sun, and night to thoſe places which are turned *from* the Sun. Thus turn upon its Axis that part of the Globe which is marked E, exactly even with the Sun, ſo that this letter E may be directly between the center of the Earth and Sun. In this ſituation, with an inhabitant at E, or *England*, it would be juſt twelve o'clock at noon or mid-day, the Sun then being in our Meridian, or nearly over our heads; but to an inhabitant at A, which are our *Antipodes*, it would be dark night, as the Orrery ſhews them to be quite turned away from the Sun, and at the ſame inſtant that we at E, or *England*, are beholding the Sun over our heads, they would have it night, and (if not cloudy) ſee the Planet *Saturn* ſhining over their heads; from this poſition it follows, that the *Antipodes* * muſt walk with their feet towards ours;

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* Aſtronomers, though they know and teach the contrary, yet in their common converſation ſay, *the Sun riſes, the Sun ſets, the Sun moves*, &c. for was they to alledge the motion to be in the Earth, they would be under the neceſſity of explaining themſelves every time they ſpoke to the vulgar on that head. But there are many places in Scripture which clearly aſſert the ſituation, motion, figure, &c. of the Earth; plurality of Worlds, Antipodes, &c. As firſt, where God is ſaid *to frame the* WORLDS *by his word*; now *Worlds* muſt imply more than one. Again, the Scripture tells us, Iſaiah xi. ver. 22. *It is he that ſitteth upon the circle of the Earth*; *He made the round World*, that is, the World or Earth we inhabit muſt be globular. *He hung the World upon nothing*, Job xxvi. ver. 7. that is, ſuſpended it in the immenſe void; we alſo read in Iſaiah, *that the Earth turneth, and the Earth is moved by the Lord*. Again, in Heb. xi. ver. 3. *the Worlds were framed by the word of* GOD.

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* It may be objected that if the Earth is round, and every way in form of a Globe, that thoſe people which inhabit that part of the world which is oppoſite to us, muſt needs have their feet towards ours, that is what we call our *Autipodes*, and therefore appear to us as if they walked with their heads hanging downwards, in which caſe it may be aſked what can hinder them from falling down altogether. But was this very queſtion put to one of theſe people, *i. e.* our *Antipodes*, they would have the very ſame reaſon to fear we ſhould fall from our Earth, for we appear with our head downwards to them juſt as they do to us. Again, it cannot be that any ſhould fall upward towards Heaven, that would be to be raiſed on high not to fall down. Our *Antipodes* could give the ſame reaſon that they cannot fall upwards or towards Heaven, ſince that would be only raiſing on high which is not falling, and ſince the Heavens is over their heads as much as it is over ours, to fall from their part of the Earth would be to be carried aloft as much as it is here with us. In a word, towards Earth is *downwards*, and towards the Heavens *upwards*, on whatever part of the Globe we ſtand. Thus it is we are not afraid leaſt a ſhip while ſhe is in the oppoſite part of the Ocean ſhould fall out of the Sea, we may as well ſuppoſe the water of the Sea itſelf ſhould fly off to the clouds; it may be aſked what hinders a ſhip in this part of the Sea from falling from the Sea to the Clouds. I anſwer her weight, for her weight, (according to the laws of gravity) tend towards the Earth; as by attraction or gravitation all things tend towards the Earth, even as thoſe *Antipodes* who have their feet to ours; nor can we ſay, to ſpeak accurately, that the *Antipodes* are below us, more than that we are below the *Antipodes*. The weight of the Atmoſphere and attraction of the Earth, occaſions every ſubſtance about us to incline towards the Earth; thus it requires force to raiſe a ſtone or any other thing from the Earth as well with our *Antipodes* as with us, and when forced upwards it will fall back of itſelf to the Earth at the *Antipodes* equal as with us. Thus no

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turn the Earth round upon its Axis according to the progreſſive order of the Signs, for that is the true motion of the Earth, *i. e.* from Weſt towards the Eaſt, therefore by placing the top of the Orrery towards the *South*, the Signs will have the ſame courſe in the Orrery as they actually have in the Heavens, and turn the Earth on its Axis towards the Eaſt, thus will it accurately correſpond with the real motion of the Earth. And now bringing S under the Sun, you will ſee E withdraw itſelf from the Sun; in this ſituation the inhabitants of E, or *England*, would be almoſt turned away from the Sun, making it 6 o'clock or evening, when at S it would be mid-day, or 12 o'clock at noon. Turn the Earth round till A, our *Antipodes*, get under the Sun, then it will be 12 o'clock, or noon-day at A, our *Antipodes*, or *New Zeland*, while it is 12 o'clock at night with us in *England*, and thus will the face of Nature be altered, for now we ſhall behold *Saturn* over our heads, when twelve hours before had the Sun in our Meridian. Thus in *February* and *March* 1774, *Saturn* will appear very conſpicuous to us in the evenings, but will be inviſible towards the latter end of the Summer. Thus by placing the Orrery as directed and gently moving the Earth upon its axis towards the Eaſt, you will obſerve all places eaſtward will firſt come under the Sun; thus C, which is *China*, will paſs under the Sun before E, or *England*, as *China* lies conſiderable more *Eaſt* than *England*: But S, or the *Great South Sea* which lies Weſtward, will not paſs the Sun till after *England*; it therefore follows that while the Sun is riſing with us it is noon-day at *China*, Sun ſet with our *Antipodes*, and near midnight to thoſe then ſailing in the *Great South Seas*, and all theſe diverſity of appearances is demonſtrated by the Orrery to be occaſioned by the diurnal or daily motion of the Earth.

ſide of the Globe can claim the priviledge of being the upper ſide, or reckon the oppoſite part the under ſide of the Earth, and Providence has likewiſe been ſo impartial in his all-wiſe laws, that in a year all parts of the World have an equal and proportionable ſhare of the Sun's light.

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PROBLEM VI.

To know what Stars will be upon our Meridian, as alſo thoſe Stars which are riſing and ſetting at 12 o'clock for any night in the year.

THIS is performed by bringing the Earth in its orbit to its proper place for the given time, and turning the letter E, which means *England*, quite away from the Sun, then whatever Signs in the Zodiac or outward circle are over E, will be actually over our heads at 12 o'clock at night, while thoſe Stars to the Eaſt as we turn towards them will appear to riſe, and Weſtward to ſet.

EXAMPLE. Suppoſe the time required was the latter end of *March?* Bring the Earth to A in its orbit, its place at that time; turn the letter E from the Sun, then will the Sign ♎ *Libra* be upon the Meridian of *England*, or over our heads at 12 o'clock at night, as alſo the Planet *Saturn*, which is near this Sign.—Thus we obſerve the Sign *Libra* is conſpicuous to us in the Spring; but in the Summer when the Earth is at B, we loſe ſight of *Libra*, and ſee the Sign *Capricornus*; In Autumn the Earth has moved on to C; in this poſition the inhabitants at E, or *England*, have ♈ *Aries* over their heads at 12 o'clock at night, and as half the Hemiſphere is always viſible to us while the other half is inviſible, it therefore at the above hour ♉ *Taurus* will be ſeen ariſing with the bright *Pleiades*, while ♓ *Piſceſs* and ♒ *Aquarius* will be ſetting. The beautiful Planet *Jupiter* will be ſhining in all his ſplendor on or near our Meridian; but in the Winter, when the Earth is at D, we ſhall have loſt ſight of ♈ *Aries*, and have ♋ *Cancer* on our Meridian at 12 o'clock at night. But in the Spring, that is in *March* 1775, the Earth will have moved in its orbit to A, and thus will get between the Sun and the Planet *Mars*; for the Earth moving quicker in its orbit than *Mars*, will now have overtaken it, and conſequently we ſhall at this time have that Planet brightly ſhining in our Meridian at night.

PROBLEM VII.

To explain by the Orrery, what occaſions the New and the Full Moon, as alſo its different appearance in its Quarters.

The reaſon of the Moon appearing to us in theſe different phaſes[*] proceeds from two cauſes, that is its *globularity*[†], and motion, in its orbit between the Earth and the Sun; for, whenever the Moon is between the Earth and the Sun, we call it *New Moon*, the enlightened part being then turned from us; and whenever the Earth is between the Sun and Moon, we then call it *Full Moon*, its whole enlightened part being then toward us.

For Example.—We have a *New Moon* on the 12th day of March, 1774. By examining the *Ephemeris* for that time, we ſhall find the Earth's place to be about 23 degrees in ♍ *Virgo*; therefore move the Earth in its or-

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[*] Not only the Moon, but the inferior Planets (*i. e.* ☿ and ♀) going round the Sun in leſs orbits than our Earth, will ſometimes have more, ſometimes leſs of the illuminated Hemiſphere turned towards us, and conſequently, through a good teleſcope, will appear to have all the *Phaſes* we ſee in the Moon. Yet thoſe Planets, by reaſon of their diſtance, will appear round to the naked eye. The ſuperior Planets, i. e. ♂, ♃, and ♄, going round the Sun in orbits larger than our Earth, always turn much the greateſt part of their illuminated Hemiſphere towards our Earth, which, compared with their diſtances, eſpecially ♃ and ♄, is near the Sun, i. e. our Earth is near the Sun compared with thoſe Planets; and therefore they will appear always round or full, except Mars a little gibbous, and in his quadratures, through a good teleſcope, almoſt biſected; the ſuperior Planets appearing always full is a proof of their going round the Sun in larger orbits.

[†] The ingenious Mr. Ferguſon has favoured us with the following agreeable experiment to prove the *globularity* of the *Moon*.—Between the third quarter and change the Moon is frequently viſible in the forenoon, even when the Sun ſhines: and then ſhe affords us an opportunity of ſeeing a very agreeable appearance: wherever we find a globular ſtone above the level of the eye, as ſuppoſe on the top of a gate; for if the Sun ſhines on the ſtone, and we place ourſelves ſo as the upper part of the ſtone may juſt ſeem to touch the point of the Moon's lowermoſt horn, we ſhall then ſee the enlightened part of the ſtone exactly of the ſame ſhape with the Moon, horned as ſhe is, and inclining the ſame way to the Horizon. The reaſon is plain; for the Sun enlightens the ſtone the ſome way as he does the Moon; and both being globes, when we put ourſelves into the above ſituation, the Moon and ſtone have the ſame poſition to our eyes; and therefore we muſt ſee as much of the illuminated part of the one as of the other.

N. B. The

bit near to the letter A; ſo that the center of the Earth * may be under 23 degrees of *Virgo*. The *Ephemeris* deſcribes the Moon to be at that time in 23 degrees of ♓ *Piſces*: therefore extend a thread from 23 degrees in ♓ *Piſces*, to the Earth's center, and turn the Moon to that part of its orbit where the thread cuts; then will you have the Moon 23 degrees in *Piſces*. Thus will the Moon be exact † between the Earth and Sun; and conſequently its enlightened part turned towards the Sun: we therefore cannot receive any benefit from the Moon till it has got a little from the Sun, which, by its quick motion, it will perform in two days, as the Ephemeris will ſhew that, in two days time, it will have got into 18 degrees ‡ of ♈ *Aries*; and thus a ſmall part of the enlightened Moon will juſt after ſun ſet be conſpicuous, and is what we term the *New Moon*; and will more and more ſhew its enlightened parts to us as it gets from the Sun, leaving a greater ſpace opened between the Moon and Sun for the inhabitants of the Earth more advantageouſly to behold it, and receive its beneficial light §. Had Providence given the Moon a ſlower motion, we ſhould

N. B. The inclination of that part of the Ecliptic to the Horizon, in which the Moon is at any time when horned, may be known by the poſition of her horns, for a right line, touching their poiuts is perpendicular to the Ecliptic.

* To ſet the Earth, Moon, or Planets accurately in the Orrery, you ſhould have a ſmall ſtring: one end of this ſtring ſhould be held at that degree of the Sign in the outward circle of the Zodiac, in which the Planet is deſcribed to be. The other end ſhould be extended to the center of the Sun: the Earth or Planet ſhould then be fixed in that part of its orbit which the ſtring interſects. Thus, for the above queſtion, extend a ſtring from 20 degrees of Virgo to the Sun; it will cut the Earth's orbit nearly at A; there place the Earth.

† By examining the fourth column of the Ephemeris (which is the Moon's latitude or diſtance from the Ecliptic); in this column you will ſee 0 S. 5, which implies the Moon is no degrees South latitude, i. e. in the Ecliptic, and therefore at this time there muſt be a Solar Eclipſe.

N. B. The Moon's orbit croſſes the Earth's orbit in almoſt the ſame manner as two hoops put croſs, the one within the other; and thoſe places where the orbits croſs each other are by Aſtronomers called the Moon's Nodes. The Moon muſt be in one of theſe Nodes to occaſion an Eclipſe.

‡ The Moon's motion in her orbit is near 13 degrees in 24 hours.

§ To a ſpectator in the Moon our Earth would appear to have all the Phaſes of the Moon.

have been for a long time together deprived of this uſeful light. By examining the Ephemeris again for the 20th day of March you will find the Moon is advanced forward to 1 degree in ♋ *Cancer*. In this ſituation we ſee a conſiderable part of the Moon's body, being called its firſt quarter, and have now Moon-light nights, as may be ſeen by letting the Moon remain under ♋ *Cancer*, and turning the Earth upon its axis, for then a ſpectator at E would be no ſooner, by the Earth's motion, turned from the Sun, than he would have the Moon ſhining very conſpicuous, and ſo continue till E turns again toward the Sun, which would be about one o'clock in the morning; then will E be turned from the Moon, and conſequently the Moon will ſeem to ſet with us at E, or in England.

Again examine the Ephemeris, and you'll find a full Moon* on the 27th day of *March*, 1774: the Earth by this time will have advanced in its orbit to near ſeven degrees in ♎ *Libra*. Bring the Earth therefore forward in its orbit, till its center paſſes A, that is till the Earth is oppoſite ſeven degrees of ♎ *Libra*. The third column of the Ephemeris deſcribes the Moon at the above time to be in 0 degrees, or juſt entering the Sign ♎, therefore bring the Moon exactly under the Sign ♎ *Libra*; thus will the Earth be exact between the Sun and Moon; conſequently a full Moon, as the whole enlightened part of the Moon will be towards the Earth. We ſee in this poſition of the Orrery the Moon and ♄ Saturn will then be near each other†, and this will be their exact appearance in the heavens; and about this time, ſhould the evenings be fine, a very agreeable obſervation may be made of the heavenly bodies. As on the 25th of *March* in the evening the Moon will be ſeen a tolerable diſtance weſtward of the Planet ♄ *Saturn*, on the 26th in the evening the Moon will be cloſe to this Planet, and on the 27th the Moon will have paſſed the Planet, and got eaſtward of it, which demonſtrate the ſwiftneſs of the Moon's * motion. The Moon will be in its laſt quarter on the 3d of *April*, at which time the Moon is in 11 degrees of ♑ *Capricornus*; therefore let the Earth continue in the Orrery nearly where it was, and extend a thread from the Sign ♑ *Capricornus* (which is in the outward circle) to the center of the Earth (which remains at A) and bring the Moon to that part of its orbit which the line interſects; then will the Moon be under 11 degrees of ♑ *Capricornus*. In this poſition, when a ſpectator at E upon the Earth is firſt turned away from the Sun, which makes evening. He could not ſee the Moon but towards morning, as that part of the Earth is again to the Sun, the Moon would then be ſeen; and thus would it appear in the heavens, for being in its laſt quarter, cannot be ſeen till towards the morning. As is eaſily demonſtrated by the Orrery.

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* The Moon circulating round our Earth in a much leſs orbit than the Earth revolves in round the Sun. Sometimes more, ſometimes leſs, ſometimes none of her enlightened hemiſphere will be towards us; and therefore ſhe muſt appear a *New Moon*, a *Creſcent*, a *Half Moon*, *Gibbous*, a *Full Moon*, &c. Theſe various appearances are called the Phaſes of the Moon.

The obſcure light viſible in the Moon a little before and after conjunction (or New Moon) is reflected upon her from the Earth.

† The Moon and Saturn being near each other in the ſame Sign, is what the Aſtronomers call a conjunction, and thus marked ☌.

PROBLEM VIII.

To explain by the Orrery why the Planets are ſometimes morning, and ſometimes Evening Stars.

This is occaſioned by the different ſituations of the Earth.

EXAMPLE.—Bring the Earth in its orbit to D, which is its true place in *December*, then turn the Earth gently round upon its Axis, * you will then obſerve that a ſpectator on the Earth at E would not ſee the Planet ♄ *Saturn* till towards the morning, that is, till E was turning towards the Sun, and therefore the Planet *Saturn* in this poſition of the Earth would be called a *morning Star*; move the Earth on in its orbit a little beyond A, the Earth's place in *April* (that is nearly between A and B) and then you'll obſerve, by revolving the Earth on its Axis, that a ſpectator at E would no ſooner by the Earth's motion be turned away from the Sun, than the Planet *Saturn* would become conſpicuous; and this being at the time commonly called Sun-ſet, it will conſequently be termed an *evening Star*, and by bringing the Earth on in its orbit to C, (the Earth's place in *September*) *Saturn* will then become totally inviſible to all the inhabitants on our Globe, the Sun at that time being between *Saturn* and the Earth, muſt therefore ſolely obſcure that Planet. This is not only demonſtrated by the Orrery, but may alſo be demonſtrated by Nature; for ſhould any one contemplate the Heavens at the above times, he would find thoſe celeſtial bodies in that immenſe canopy accurately correſponding with what the Orrery hath deſcribed, and by the above rules it may be predicted when any of the Planets will be morning or evening Stars, and when viſible or inviſible; but attention muſt be had to their proper places, which is ſhewn by the Ephemeris.

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* This will alſo demonſtrate the Moon's real track in the heavens. To a common obſerver ſhe ſeems to move from Eaſt to Weſt; but this explains the contrary, and deſcribes the Moon's true motion to be from Weſt to Eaſt. Indeed this may be evinced by only obſerving the New or a little after the New Moon; look what hour it is by your watch, then place yourſelf ſo as to ſee the Moon juſt over ſome ſpire or chimney. The next evening, at the ſame hour or exact time, place yourſelf on the ſame ſpot you before ſtood; then by obſerving the Moon, you will obſerve ſhe has got conſiderably *eaſtward* of that ſpire or chimney, where you obſerved her before. The diſtance between where the Moon was and now is, will be about 12 degrees and a half, which will enable you to form ſome judgment of the ſpace of a degree in the heavens.

* Whenever the Earth is turned upon its Axis, it muſt always revolve according to the order of the Signs, that is from Weſt to Eaſt, being the true diurnal motion of the Earth. The progreſſive order of the Signs in the Zodiac, as in the outward circle of the Orrery, are

PROBLEM IX.

Required when the Planets are moſt remote, and when neareſt the Earth?

The ſolution of this Problem alſo, chiefly depends upon the Earth's motion in its orbit.

Example. Bring the Earth in its orbit to C, its real ſituation in *September*, you will then obſerve that the Planet *Saturn* is at a great diſtance from the Earth; but bring the Earth to A, and *Saturn* will be much nearer the Earth; this proves the immenſe diſtance of the Planets, that are ſeen from any part of the extenſive orbit of the Earth, it occaſions

are arranged as follows; ♈, ♉, ♊, ♋, ♍, &c. the Signs are read from the right-hand to the left, contrary to our method of writing, but was the way the *Egyptians* accuſtomed themſelves to write, which method is ſtill practiſed by the *Jews*.

but little difference in their apparent magnitude. Bring the Earth in its orbit to B, the Earth's place in *June*, at which time ♃ *Jupiter* will be at a conſiderable diſtance; but bring the Earth on between C and D, (its place in *October*) the Earth will then be much nearer *Jupiter* than when at B. Thus the Earth's vicinity to, or diſtance from a Planet, is according as the Earth's ſituation in its orbit reſpects that Planet; when a Planet is at the *greateſt* diſtance poſſible from the Earth in its whole revolution, it is then ſaid, by Aſtronomers, to be in *Aphelion*, and when a Planet or Comet is in that point of its orbit which is *neareſt* the Earth, it is called *Perihelion*, in which ſenſe it ſtands oppoſite to *Aphelion*.

PROBLEM X.

To demonſtrate the reaſon why neither Mercury *or* Venus *can be ſeen on the Meridian of* LONDON *at mid-night, as all the other Planets at certain times are.*

THE reaſon is obvious, for both the orbits of *Mercury* and *Venus* are between the *Sun* and the *Earth's* orbit, therefore the Earth moves in a circle beyond them. Now a Planet muſt move in a circle beyond the Earth's orbit, to be on our Meridian in the night when the Earth is turned from the Sun; this is very clear by obſerving the Orrery. By bringing the Earth between C and D (its place in *October*) and turning E upon the Earth from the Sun, which makes it night at E, a ſpectator then at E, or *England*, would have ♃ *Jupiter* upon their Meridian at mid-night. Move the Earth on in its orbit a little beyond D, and ♂ *Mars* will be upon our Meridian at mid-night; continue the Earth on in its orbit to A, (the Earth's ſituation in *March*) and then we ſhall have *Saturn* nearly upon our Meridian at mid-night; but you cannot place the Earth in any part of its orbit ſo as to have either ☿ *Mercury* or ♀ *Venus* over E, on the Earth (or *England*) when turned away from the Sun, which demonſtrates that *Venus* and *Mercury*, contrary to all the other Planets, can never be on our Meridian.

PROBLEM XI.

To deſcribe the Tranſit of Mercury *or* Venus.

THE Tranſit of either of thoſe Planets ſignify their paſſing exact between the Earth and Sun; when viewed at the time of a Tranſit by a * Teleſcope, they will appear as a black ſpot upon the Sun. By placing the Earth in its orbit between D and A, you will ſee ♀ *Venus* and ☿ *Mercury* nearly in the poſition of a Tranſit; but an actual Tranſit ſeldom happens, by reaſon that the orbits of *Mercury* and *Venus* are ſomewhat oblique to that of the Earth, and therefore theſe inferior Planets are but rarely in a direct line with the Sun and Earth.

There was a Tranſit of *Venus* in the year 1761 and 1769, and will be again in 1996 and 2004, in the month of *June*, and in the year 1874, 2109, 2117, in *December*, at which times ſhe will appear a black but beautiful ſpot on the Sun.

Mercury did tranſit the Sun in 1736 and 1743, 1756, 1759, and will again 1776, 1782, 1789 in *October*, and in the year 1753, 1786, 1799, in the month of *April*.—I have inſerted theſe few Problems by way of example; but the ingenious reader will be able to propoſe and ſolve many more.

SECTION XX.

Remarks on the Motion of the EARTH *and other* PLANETS.

A Philoſophic obſervation of the former Problems muſt evince, (even the moſt obdurate Atheiſt) that there are two manifeſt demonſtrations of the preſence and management of GOD, namely, that ſuch bodies ſhould move at all, and that their motions are ſo regular. *1ſt.* That all thoſe vaſt Globes of the univerſe ſhould have a motion muſt of neceſſity be from ſome being that had power enough to put them in motion. For as † *Lactantius* well argues, "There is indeed a power in the Planets of performing their motions, but that is the power of God who made and governs all things, not of the Planets themſelves that are moved," it being impoſſible for ſuch lifeleſs, huge, unweildly bodies to move themſelves, therefore what motion they have muſt be received from ſome other cauſe, and that cauſe exceeding powerful, as not only being able to move them, but alſo to keep them in motion, and to continue that motion which has powerfully acted upon them from the Creation to the preſent hour.

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* In obſervations of the Sun a ſmoaked glaſs ſhould be added to the Teleſcope to prevent injuring the ſight.

† *Lactant Divin. Inſtit.* L. ii. c. 5.

Now this, ſome will ſay, may be effected by the vortices ſurrounding the Sun, the Earth, or other primary movers, * or from a vectorial power or emanations of the Sun, † or other like primary movers carrying about, and puſhing on ſuch bodies as move about them. But allowing it poſſible that it might be ſo, yet ſtill we muſt recur to ſome *firſt mover*, ſome *primary Agent*, who was able to ſet that principal mover into motion, and then the caſe amounts to much the ſame, and the argument hath the ſame force, whether we attribute the motion of one or all the ſeveral Globes to the power of God. Thus in our Solar Syſtem, for inſtance, if it ſhould be thought that the ſix primary Planets revolving round the Sun received their motion from his revolution round his own Axis, yet let us think as PLATO *argues*, how is it poſſible for ſo prodigious a maſs to be carried round for ſo long a time by any natural cauſe? For which reaſon, ſays he, I aſſert God to be the cauſe, and that it is impoſſible it ſhould be otherwiſe. Thus *Plato*, ‡ whoſe argument is undoubtedly

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* This was *Carte*'s notion, and of others long before him.

† This was *Keple*'s ſcheme.

‡ It is univerſally allowed, that *Plato* had ſome knowledge of the Supreme Being, or only true God, either from the light of Nature, or from an inſpection of the writings of the ſacred Pen-men of the *Old Teſtament*. It muſt be acknowledged, however, likewiſe, that there were numbers of ſuch Philoſophers, *who* (as St. *Paul* expreſſes it) *having known God, did not glorify him as God*, but were bewildered, and walked in the dark, following the dictates of their own vain and fooliſh imaginations. In ſhort, he maintained, in his Treatiſe entituled *Epinomis*, three diſtinct Deities; that is to ſay, the ſuperior Gods, middle Gods, and ſuch as were inferior to them both, whom he diſtinguiſhed by the name of Demons. In all probability, *Plato* grounded his notion of the middle Gods on what is ſaid in the ſacred Scriptures concerning the Angels.

doubtedly good, ſince as the moſt ingenious Mr. *Molyneux* (ſpeaking of the motion of the Planets) ſays, " From hence we may juſtly fall into the deepeſt admiration that one and the ſame law of motion ſhould be obſerved in bodies ſo vaſtly diſtant from each other, and which ſeem to a caſual eye, to have no dependence or correſpondence with each other. This doth moſt evidently demonſtrate, that they were all at firſt put into motion by one and the ſame *unerring hand*, even the infinite power and wiſdom of God, who hath fixed this order amongſt them all, and hath eſtabliſhed a law which they cannot tranſgreſs. Chance or dull matter could never produce ſuch an harmonious regularity in the motion of bodies ſo vaſtly diſtant: for if in our ſolar Syſtem we ſhould imagine the Moon to be wheeled about our Earth, and the Moons about *Saturn* and *Jupiter*, by the motion and vectorial power of thoſe Planets, and all the primary Planets to be revolved about the Sun by the power of the Sun, yet, at laſt we muſt find out a mover of the Sun itſelf, and thoſe other primaries; a cauſe of ſufficient power to wheel about thoſe prodigious maſſes of ſuch vaſt bulks as have before been aſſigned to them, and which, beſides their own weight, are according to the former hypotheſis, clogged and encumbered with the *vis inertiæ* of all thoſe Planets, whether primary or ſecondary, or both, which they drive round, and if this was the caſe, what power can be found ſufficient for this work but that of the ſame *infinite ſupreme hand* that at firſt gave them being! Thus the bare motions of the Earth and of the Heavens are ſo many arguments of a divine power therein concerned. A manifeſt demonſtration of a Deity; and will teach the good, the candid mind, that all mankind have infinite obligations

Plato likewiſe maintained the doctrine of the Metempſeuchoſis, which he borrowed, indeed, from *Pythagoras*, but very greatly improved it, as is apparent from his Dialogues, entitled *Phædrus*, *Phædon*, *Timæus*, &c. Notwithſtanding *Plato* publiſhed a moſt excellent Treatiſe on the immortality of the ſoul, yet he ran into ſeveral very groſs errors.

However, without expatiating any farther on the doctrines of this Philoſopher, which we have tranſmitted to us but in a very dark and imperfect manner; we ſhall only obſerve, that his notions on divers important articles, ſeemed ſo novel, and ſo ſublime, that he in reality merited the high and venerable Title which he obtained in his life-time, namely, that of *Plato the Divine*. He died in the firſt year of the 108th *Olympiad*, in the 81ſt year of his age, and, what is ſomewhat remarkable, on his very birth-day.

obligations to the ALMIGHTY, who requires no other return for all his unbounded goodneſs, than what is abſolutely neceſſary for man's felicity to comply with; for we are commanded to adhere unto Virtue and to ſhun Vice. I ſhall therefore make a ſhort digreſſion with an endeavour to explain, in a moral ſenſe, the different operations of Vice and Virtue, in order to prove that the mercy and benevolence of the Deity is as conſpicuous in his laws to man as in his laws of Nature.

The Deity formed man for happineſs, which can only be attained by the love and practice of VIRTUE. But this will further appear by comparing the conſequences of Virtue and Vice; it is the Province of virtue to preſerve the reaſon clear and compoſed, it gives a tranquility of mind and ſweetneſs of temper, prone neither to ſuſpicion, nor to revenge; it views men and things in the faireſt light; and rejoices more in giving than in receiving pleaſure; it gives a nobleneſs of ſpirit, that enables the good man to ſupport power without inſolence, honour without pride, wealth without parſimony or profuſion, and inſpires him with a fortitude, that enables him to riſe above all the misfortunes to which mankind are liable.

On the other hand, it is the Province of vice to diſturb the reaſon, and give diſſipation of thought, to amuſe the mind with emply hopes, and fill the breaſt with fear, anxiety, and remorſe; to raiſe inſatiable deſires after pleaſure, wealth, and honour, and a painful antipathy againſt his competitors; to render a man inſolent to all below him, envious and yet fawning to all above him, and full of ſuſpicions and jealouſies of all mankind; to hate, and be hated; to be without a friend, on whom he can confide, and inſtead of having the conſolation ariſing from an approving mind, to have his breaſt the ſeat of pride, petulance, malice, and revenge; and his body the ſeat of the moſt painful and loathſome diſeaſes.

In ſhort, the pleaſures which the vicious enjoy, depending chiefly on ſenſual gratifications, are palled with ſatiety, and mingled with fear and remorſe, they depend on innumerable accidents, and on the humours and caprice of mankind, but the enjoyments of the good man are exquiſite and laſting; they are damped with no inward checks, and are always attended with dignity and ſelf-approbation; they are ſeated within, and out of the reach of the caprice of mankind; force cannot rob us, nor fortune cheat us of them; they do not change with circumſtances nor grow old with time; but while the tranſports of vice laſt but for the preſent moment, and are imbittered with the dread of an offended Judge and future reckoning, thoſe of virtue, extend in proſpect to an endleſs futurity, are heightened by the delightful hopes of the divine approbation, and the everlaſting joys that flow from the favour of the Almighty.

In Chriſtian hearts, O for a Pagan zeal!
A needful, but opprobrious pray'r! As much
Our ardour leſs, as greater is our light.
How monſtrous this in morals! Scarce more ſtrange
Would this phænomenon in nature ſtrike,
A ſun that froze us, or a ſtar that warm'd.
What taught theſe heroes of the moral world?
To theſe thou giv'ſt thy praiſe, give credit too.
Theſe doctors ne'er were penſion'd to deceive thee;
And Pagan tutors are thy taſte.—They taught,
That narrow views betray to miſery:
That wiſe it is to comprehend the whole:
That Virtue roſe from Nature, ponder'd well,
The ſingle baſe of Virtue built to heav'n:
That GOD, and Nature, our attention claim:
That Nature is the glaſs reflecting GOD.
As, by the ſea, reflected is the Sun,
Too glorious to be gaz'd on in his ſphere:
That mind immortal loves immortal aims:
That boundleſs mind affects a boundleſs ſpace:
That vaſt ſurveys, and the ſublime of things,
The ſoul aſſimilate, and make her great:
That, therefore, heav'n her glories, as a fund
Of inſpiration, thus ſpreads out to man.
Such are their doctrines; ſuch the Night inſpir'd.
And what more true? what truth of greater weight?
The ſoul of man was made to walk the ſkies;
Delightful outlet of her priſon here!
There, diſincumber'd from her chains, the ties
Of toys terreſtrial, ſhe can rove at large;
There, freely can reſpire, dilate, extend,

In full proportion let looſe all her pow'rs;
And, undeluded, graſp at ſomething great.
Nor, as a ſtranger, does ſhe wander there;
But, wonderful herſelf, through wonder ſtrays;
Contemplating their grandeur, finds her own;
Dives deep in their œconomy divine,
Sits high in judgment on their various laws,
And, like a maſter, judges not amiſs.
Hence, greatly pleas'd, and juſtly proud, the ſoul
Grows conſcious of her birth celeſtial; breathes
More life, more vigour, in her native air;
And feels herſelf at home among the ſtars;
And, feeling, emulates her country's praiſe.
What call we, then, the firmament, LORENZO!—
As earth the body, ſince the ſkies ſuſtain
The ſoul with food, that gives immortal life,
Call it, The noble paſture of the mind;
Which there expatiates, ſtrengthens, and exults,
And riots through the luxuries of thought.
Call it, The garden of the DEITY,
Bloſſom'd with ſtars, redundant in the growth
Of fruit ambroſial; moral fruit to man.
Call it, The breaſt-plate of the true High Prieſt,
Ardent with gems oracular, that give,
In points of higheſt moment, right reſponſe;
And ill neglected, if we prize our peace.

YOUNG.

SECTION XXI.

Directions for making an ORRERY.

THIS is intended as an amuſement for thoſe juvenile readers, who are curious and have leiſure. The plate fronting this page is a blank Orrery, nearly reſembling the moveable Orrery, as in page 110.

By a little contrivance, this blank Orrery may be made not only to contain all the Planets, but to have them all moveable in their reſpective orbits, and may then be ſet, ſo as at any hour by day or night to correſpond with their real place in the Heavens.

By this Orrery a great number of uſeful and entertaining Problems may be performed.

To make this inſtrument, proceed as follows: take the whole plate out of the book; then with a pair of ſciſſars cut out each orbit from the Orrery in the ſame manner as the Earth's orbit is cut out of the moveable Orrery, page 110. When all the orbits are thus cut out, paſte a piece of paper at the back of the Orrery; then either paſte or ſew the orbits in again, being careful to leave room for the Planets freely to revolve therein. You may draw the Planets * on a piece of paper, and fix them in their reſpective orbits, in the ſame manner as you ſee the Earth is contrived in page 110. This inſtrument, when finiſhed, will afford the ingenious much entertainment, as not only all the former problems may be performed by it, but ſeveral more; and indeed a little practice will enable an attentive applicator to ſolve moſt of the phænomena of the Celeſtial Bodies. The method of uſing of it will be extremely eaſy. For example, ſuppoſe it was required to ſet this Orrery for any given day, ſo as the ſeveral Planets therein might faithfully repreſent the places of the real Planets in the Heavens. To perform this, examine an Ephemeris, which will ſhew you in what Signs all thoſe Planets are for the given day. Set the Planets under the ſame Signs and degrees in the Orrery as deſcribed

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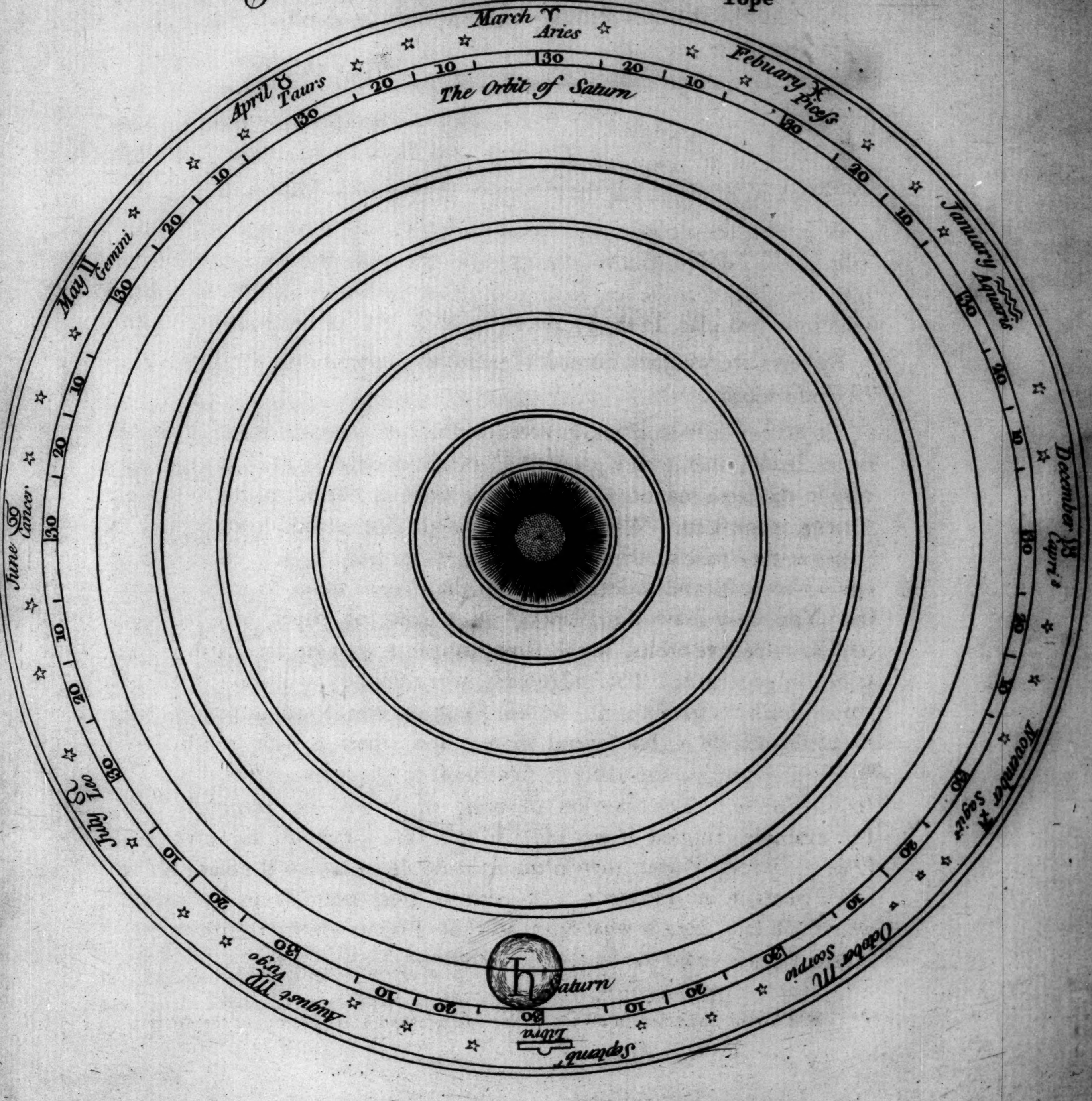
* **The different characters of all the Planets are prefixed at the bottom of the Orrery.**

The ORRERY

Go wondrous Creature! mount where Science Guides
Go Measure Earth, Weigh Air & State the tides
Teach us what Course the Various Planets run
Correct Old Time & Regulate the Sun

Pope



♄ ...... *Saturn*
♃ ...... *Jupiter*
♂ ...... *Mars*
⊕ ...... *Earth & Moon*
♀ ...... *Venus*
☿ ...... *Mercury*

in the Ephemeris; and thus you have repreſented on the Orrery the real places which thoſe ſeveral Planets actually poſſeſs in the Heavens.

N. B. The characters of all the Planets (by which you may draw them) are at the bottom of the Orrery,—and the Solar ſyſtem, page 90, will ſhew you the proper orbit of each Planet.

SECTION XXII.

The Phænomena of the CELESTIAL BODIES *for the preſent Year* 1774.

I HAVE calculated ſome few appearances of the Heavenly Bodies for the preſent year 1774, as an inſtruction to thoſe that are unacquainted with thoſe Planetary Globes; and have deſcribed the different parts in the Heavens that they will variouſly occupy, in order that they might be the more eaſily known and diſtinguiſhed. This will afford an opening rational mind much entertainment—to contemplate the variegated curious vaulted Canopy, by obſerving from time to time the regular order and infinite wiſdom in the grand machinery of Nature, and will be productive of both pleaſure and profit to the judicious obſerver. The Planets, by their motion round the Sun, are not always ſeen in the ſame part of the Heavens, but ſometimes in one place, and ſometimes in another. And hence they acquired the name of *Erratics* or Wanderers. They are eaſily known from the fixed Stars, by their ſteady light; whereas the fixed Stars * always twinkle.

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* The number of *Stars* diſcoverable in either Hemiſphere by the naked eye is not above a thouſand. This at firſt may appear incredible, becauſe they ſeem to be without number: but the deception ariſes from our looking confuſedly upon them, without reducing thoſe ſparkling bodies into any order; for look but ſtedfaſtly upon a pretty large portion of the ſky, and count the number of ſtars in it, and you will be ſurprized to find them ſo few: but, by the aſſiſtance of a teleſcope, much larger numbers are diſcovered.

For ſeveral evenings during the month of *February*, the following Planets will be very conſpicuous.

Weſtward of our meridian, and rather high in the Heavens, immediately after ſun-ſet, will be ſeen thoſe two large and beautiful Planets *Jupiter* and *Venus*; they will appear very near each other. Thoſe who are provided with a reflecting Teleſcope may eaſily diſtinguiſh *Jupiter* from *Venus*, as the glaſs will diſcover the Moons of *Jupiter* * revolving round him; beſides which, the Belts of *Jupiter* ſerve to diſtinguiſh him from the other Planets. Thoſe that are not furniſhed with a teleſcope, may diſtinguiſh *Venus* from *Jupiter* in the following manner. Obſerve the Heavens about the beginning of *February*, and ſhould the evenings prove fine) you will ſee thoſe two large Planets appear towards the South, and not far from each other, immediately after ſun-ſet. That Planet toward the Weſt will be *Venus*, the other more South is *Jupiter*.—*Venus* will firſt deſcend below our horizon, then *Jupiter*; for at this time, *i. e.* the beginning of *February*, *Venus* ſets about nine, and *Jupiter* near ten o'clock in the evening. And thus theſe Planets may be known, by remarking that which ſets firſt muſt be *Venus*. But towards the latter end of *February*, they will be ſeen almoſt cloſe to each other, and in a fine evening have a very grand and beautiful appearance, and will ſet nearly together, being nearly in conjunction. From about the middle to the latter end of *March Venus*, by her retrograde motion, will be drawing from *Jupiter*,

March,

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* Jupiter has four Satellites or Moons, which are carried round him at the diſtances and in the Periodical Times following:

					D.	h.	′
The 1ſt	is diſtant from the center of Jupiter	5	Semi-diameters of Jupiter.	The Period of the 1ſt	1	18	28
2d		9		2d	3	13	14
3d		14		3d	7	3	43
4th		25		4th	16	16	32

Saturn has five Satellites or Moons, whoſe diſtances and Periodical Times are as follow:

					D.	h.	′
The 1ſt	is diſtant from the center of Saturn	4	Semi-diameters of Saturn.	The Period of the 1ſt	1	21	8
2d		5		2d	2	17	41
3d		8		3d	4	12	28
4th		18		4th	15	22	41
5th		52		5th	79	7	46

and may be obſerved every night to approach nearer to the Sun. Therefore, about the 15th, 16th, and 17th of this month, *Venus* will juſt appear to us a little after Sun-ſet very low in the Weſt, and will not continue more than half an hour above our horizon. On the 22d this Planet will totally diſappear, and continue inviſible for ſome time. Thoſe who noticed this Planet *Venus* in *February*, obſerved it every night drew farther from the Sun, and approached nearer to *Jupiter*.—But now it will have withdrawn herſelf from *Jupiter*, and got ſo near the Sun as to be hid from us, and totally inviſible to all the world: but in fine evenings *Jupiter* will ſtill remain a ſhort time viſible after Sun-ſet, and very low in the Weſt. About the middle of *April*, *Venus* once more favours us with her bright preſence; but ſhe is now become a *Morning Star*[*], and may be ſeen to riſe full Eaſt, juſt before the Sun, about five o'clock in the morning. In the middle of this month *Jupiter* diſappears. *Mars* is alſo a *Morning Star*, appearing near *Venus*, and at this time favours us with but little of his preſence. But that remote Planet *Saturn* is, in this month, on our meridian, about ten o'clock at night, and continues ſhining with us till near Sun-riſe. This Planet is the moſt remote from the Sun of any in our ſyſtem, ſhould *Saturn* therefore be inhabited, thoſe inhabitants, from their great diſtance, would receive but little benefit from the Sun; Providence, to remedy this inconveniency, has furniſhed *Saturn* with five Moons, and alſo added a ſurprizing luminous ring, which ſurrounds this Planet, and with its Moons muſt reflect a very ſtrong light. This ring may be ſeen by the aſſiſtance of a teleſcope; but at this time it is not in the moſt advantrgeous poſition for obſervation. The ring being now turned edgeways to us, will only appear as a line drawn obliquely croſs that immenſe Globe. About the year * 1780, this ring will appear very broad, and by the aſſiſtance of a good Teleſcope the ring will be ſeen to ſurround *Saturn* without touching the body of that Globe. Indeed the diſtance between this ring and *Saturn*'s body is ſo conſiderable, that the Stars have been ſeen through this vacancy, which not only proves the diſtance of this ring from *Saturn*'s body, but alſo the immenſe diſtance of the Stars, which muſt be far beyond *Saturn*'s orb, otherwiſe they could not be conſpicuous through his ring.

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[*] A Morning Star is, when a Planet or Star riſeth apparently before the Sun. An Evening Star is, when it ſets after the Sun. The reaſon why Venus, in ſo ſhort a ſpace, is an Evening Star—inviſible—and then a Morning Star, is occaſioned by her different motions in her orbit. At firſt, as an Evening Star, it proceeds directly in its track, according to the progreſſion of the Signs; and therefore is every day getting *from* the Sun, and drawing nearer *to* Jupiter, which may be plainly obſerved; but in the beginning of March it is retrograde, *i. e.* it alters its courſe, and travels from Jupiter toward the Sun, till having got cloſe to that luminary, it is rendered inviſible; but continuing its retrograde motion, it paſſes the Sun, and then, which will be in *April*, it appears a beautiful Morning Star.

On the 14th of the month of *April*, that large Star called *Aldebaran*, apparently touches the Moon at ten minutes after ſix in the evening, and will again appear on the other ſide at eighteen minutes after ſeven, having been hid by the Moon one hour and eight minutes. This occultation proves that the Stars are beyond the Moon's orbit, as the Moon is ſeen to paſs between us and the Star; it alſo evinces to us the ſwiftneſs of the Moon's motion, for in little more than an hour the Moon advances up, occults, and paſſes this Star. In *May*, *Saturn* is an evening, and *Jupiter*, *Mars*, and *Venus* morning Stars, and all near each other. In the month of *June* moſt of the Planets at night will be under the Earth, therefore inviſible to us. The ſhort nights in *July* and *Auguſt*, with the additional twilight, afford but little opportunity for advantageouſly viewing the celeſtial bodies. In *September Saturn* diſappears, and at the latter end of the month the Sun paſſes the Equator, makes it equal day and night over the whole world; about the middle of this month *Saturn*, *Venus*, and * *Mercury* are nearly in conjunction with the Sun, and conſequently all inviſible. But in *January* 1775, moſt of thoſe Planets will again be viſible in the evening, and beautifully decorate our Hemiſphere with their ſhining preſence.

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* Providence has adopted ſuch an invariable and regular motion to all the Planets, by which their Revolutions, Appearances and different aſpects are eaſily calculated. Thus by obſervation it is known that *Saturn*'s ring is moſt conſpicuous when that Planet is in *Gemini* or *Sagittarius*. *Saturn* is near thirty years in making one revolution in his orbit, which orbit is divided into twelve equal parts called Signs; therefore if it takes up thirty years to paſs through thoſe twelve Signs, he will be about two years and a half in paſſing through one Sign; his preſent diſtance from *Sagittarius*, is about two Signs, for the Ephemeris ſhews you that *Saturn* is almoſt in *Libra*; *Sagittarius* is about two Signs from *Libra*; *Saturn* being two years and a half in one Sign, muſt conſequently be five years in paſſing through two Signs, and therefore in the ſixth year muſt be entered into *Sagittarius*, that Sign in which the ring is moſt conſpicuous: were the Planets as irregular as man, it would be out of the power of man to aſcertain any of their aſpects. *Saturn*, though large, appears to the eye the leaſt of all Planets, by reaſon of his immenſe diſtance from us. *Saturn*'s ring is ſhut, or only appears edge ways to us like a line, when that Planet is in either *Virgo* or *Piſces*; *Saturn* is now in *Virgo*, conſequently his ring almoſt inviſible.

Let us now contemplate a little on this grand proſpect which the benevolent Creator preſents before us during the ſolemn ſilence and ſhade of night.

> Night opes the nobleſt ſcenes, and ſhades on awe,
> Which gives thoſe venerable ſcenes full weight,
> And deep reception in th' intender'd heart.

The luminaries of Heaven ſhine forth with ſuch majeſtic pomp and form a glorious ſpectacle to the eye. To the philoſophic and contemplative mind they appear ſtill more wonderful, and afford a delightful ſubject of ſpeculation. The vulgar look upon the Stars as nothing more than a multitude of bright ſpangles dropt over the ætherial blue; they have no higher notions of theſe fine appearances than that they are ſo many golden ſtuds, with which the empyrean arch is decorated. But ſtudious minds that carry a more accurate and ſtrict enquiry amongſt the celeſtial bodies, bring back advice of a moſt aſtoniſhing import.

> The more our ſpirits are inlarg'd on Earth,
> The deeper draughts ſhall they receive of Heaven. YOUNG.

Let us recollect theſe moſt ſtupendous diſcoveries, and let the unlearned remember, that the ſcene we here diſplay is the workmanſhip of that incomprehenſible Being who is perfect in knowledge and mighty in power, whoſe name, whoſe nature, and whoſe operations are great and marvellous, who ſummons into being with equal eaſe, a ſingle grain or ten thouſand worlds.

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* The Planet *Mercury* is very ſmall, and they only that find it out by the rules of Aſtronomy can know it and diſtinguiſh it from the fixed Stars. Its vicinity to the Sun occaſions ſuch a ſparkling brightneſs, contrary to all other Planets, that it may eaſily be miſtaken for a fixed Star.

Here grace with harmony allied
And wiſdom ſtrike on every ſide ;
—Alas ! to *Clody* theſe unknown,
For wond'rous Wiſdom's all his own.
In Nature nothing he ſurveys,
That actuates his ſoul to praiſe.
In vain the Planets run their courſe,
Obedient to impulſive force ;
Th' excentrick Comets far and wide,
Purſue the ſame unerring guide ;
In vain deſcribes their vary'd race,
In equal times and equal ſpace ;
In vain thro' microſcopick eyes,
Innumerable wonders riſe,
On the green leaf whole nations crawl,
And myriads periſh in its fall ;
Ah me ! what bears the barren mind ?
What beauty can effect the blind ?

SECTION

SECTION XXIII.

Remarks on the PLANETARY SYSTEM.

THE Revolutions of the Planets *round the Sun*, is called their annual, or yearly motion, becauſe they have all the alterations of the ſeaſons and varieties of the year compleat in that Revolution, and the Rotation of a Planet *round its Axis*, is called the Diurnal or Daily motion, becauſe by this means each part of their ſurfaces are carried ſucceſſively towards and from the Sun, which always illuminates that half next him, making it Day, whilſt the other half remaining in darkneſs, muſt conſtitute its Night. The periods of the Planets are known by obſerving the times of their departure from a fixed Star, till they arrive at the ſame Star again.

Of the *Polar Star* it is obſervable, that while other luminaries alter their ſituation, this ſeems invariably fixed. While other luminaries now mount the battlements of Heaven, and appear upon duty, now retire beneath the Horizon, and reſign to a freſh ſet, the watches of the night; this never departs from its ſtation. This, in every ſeaſon, maintains an uniform poſition, and is always to be found in the ſame tract of the northern Sky. How often has this beamed bright intelligence on the Sailor, and conducted the ſhip to her deſired Haven! in early ages, thoſe that went down to the Sea in ſhips, and occupied their buſineſs in great waters, had ſcarce any other ſure guide for their wandering veſſel. This, therefore, they viewed with the moſt ſollicitous attention: by this they formed their obſervations, and regulated their voyage. When this friendly guide was obſcured by Clouds, or inveloped by miſts, the trembling Mariner was bewildered on the watery waſte. His thoughts fluctuated as much as the foaming ſurge; he neither knew how far he was advanced, nor whither to direct his courſe. But when this auſpicious Star broke through the gloom, it diſſipated the anxiety of his mind, and cleared up his dubious paſſage. He re-aſſumed with all alacrity the management of the Helm, and was able to ſhape his courſe with ſome tolerable degree of ſatiſfaction and certainty, and that even in thoſe ſilent hours, when the World was locked up in quiet ſleep. Thus when night's ſable curtain is let down, and feeble Nature calls for reſt, we paſs, perhaps, the hours in ſweet refreſhing ſlumbers. Take then, friendly Reader, one ſhort leſſon to your couch, forget not the hand which protects mankind on the vaſt Ocean, that divine hand who cloſes thus your drooping lids.

The Heavens are ſtudded over with Stars as much by day as by night, only the greater light of the Sun renders them inviſible to us; but when that luminary deſcends below the Horizon, they begin gradually to appear, when the Sun is gone down about 12 degrees, then Stars of the firſt magnitude become viſible; when he is 13 degrees below the Horizon, thoſe of the *ſecond* magnitude are ſeen; when 14 degrees, Stars of the third magnitude appear, and when he is deſcended 16, 17, and 18 degrees, the Stars of the ſmalleſt ſize become conſpicuous, and the azure arch ſparkles with all its glory; to contemplate on this grand ſcene of wonders, muſt preſent the reflecting mind with a moſt unbounded, auguſt idea of the power and grandeur of the Creation, and ſhould inſpire us with the higheſt veneration for the Almighty and wonderful Architect.

——From the darkneſs broke
A dreadful voice, and thus the Almighty ſpoke,*
Who on the Earth can moderate the vein
That guides the *Stars* along the ætherial plain?
Appoint their ſeaſons, and direct tneir courſe,
Their luſtre brighten and ſupply their force?
Canſt thou the Skies benevolence reſtrain,
And cauſe the *Pleiades* to ſhine in vain;
Or when *Orion* ſparkles from his ſphere,
Thaw the cold ſeaſon and unbind the year?
Bid *Mazzaroth* his deſtin'd ſtation know,
And teach the bright *Arcturus* where to glow?
Mine is the *night*, with all her Stars I pour,
Myriads, and myriads I reſerve in ſtore.

Indeed, were there no more of thoſe ſurprizing orbs than the Sun and Planets which move about him, theſe would be ſufficient to manifeſt the goodneſs and power of an almighty and wiſe CREATOR; but when we view the Heavens and ſee ourſelves ſurrounded with ſo prodigious a number of illuſtrious bodies of various magnitudes;

Then not to Earth's contracted ſpan,
Thy goodneſs let me bound,
Or think the Lord alone of man
When thouſand WORLDS are round.

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* Biſhop *Patrick* ſays this, the Almighty's ſpeech in the 38th Chapter of *Job*, is by much the fineſt part of the nobleſt and moſt antient Poem in the world, and remarks its grandeur to be as much above all other Poetry, as thunder is louder than a whiſper.

When we go to the other parts of this our Globe from the northern, ſuppoſe to the ſouthern Pole, and there diſcover a great multitude of other Stars that were never ſeen in our Hemiſphere; when we perceive the Heavens thick beſet with them in every place, when we ſee ſuch prodigious numbers of thoſe heavenly * bodies which no art of man can number, we cannot but be ſtruck with amazement at ſuch a multitude of God's glorious works; ſo we cannot but admire, reverence, and own the great Creator in them, and we are worſe than men if we do not give him his due praiſe.

To thee whoſe Temple is all ſpace,
Whoſe altar, Earth, Sea, Skies,
One chorus let all Being raiſe,
All Nature's incenſe riſe.
POPE's *univerſal Prayer*.

* Yet not to Earth are thoſe bright luminaries
Officious, but to THEE Earth's habitant,
And for the Heaven's wide circuit, let it ſpeak
The maker's high magnificence who built
So ſpacious, and his line ſtretch'd out ſo far,
That man may know he dwells not in his own;
An edifice too large for him to fill
Lodg'd in a ſmall partition, and the reſt
Ordain'd for uſes to his Lord beſt known
The ſwiftneſs of thoſe circles attribute,
Tho' numberleſs to his Omnipotence,
That to corporeal ſubſtances could add
Speed almoſt ſpiritual. MILTON.

SECTION XXIV.

Laws of MOTION *and Orbits of the* PLANETS.

HAVING frequently mentioned the Motion and Revolution of the Planets, it becomes neceſſary to ſay ſomething relative to the LAWS OF MOTION.

LAW I. Every body preſerves its own preſent ſtate, whether it be that of reſt or uniform direct motion; unleſs it is compelled by ſome force impreſſed to change that ſtate.

A body at reſt would remain ſo for ever by its own inactivity. It is alſo evident from the merely paſſive nature of matter, which makes it naturally as impoſſible for a body of itſelf to ſtop its own motion once begun, as it is to move itſelf originally. If it were not for the reſiſtance of the Air and its own gravity, a ſtone would fly perpetually when once caſt from us.

Note, That all motion is of itſelf rectilinear, or in a right line.

LAW II. The change of motion is proportionable to the moving force impreſſed, and is always according to the direction of that right line with which that motion is impreſſed.

If any force generates any motion, a double force will generate a double one; a treble, a treble one; and this whether the force be impreſſed all at once, or ſucceſſively.

LAW III. Action and re-action are always equal, and contrary one to another.

Whatever preſſes or draws another thing, is equally preſt or drawn by it, but in the contrary way.

When a horſe draws a ſtone tied to a rope, the horſe will equally be drawn back to the ſtone. For the rope which is diſtended on both ſides, will, with the ſame endeavour of relaxing itſelf, draw the horſe to the ſtone, as it doth the ſtone to the horſe; and will ſo much hinder the progreſs of the one as it forwards the progreſs of the other. If you preſs upon the table with your hand, the reſiſtance or re-action is equal to the preſſure, and your hand is as much preſt as the table. If one body ſtrikes upon another, and thereby procures any change in its motion, it does by the reſiſtance or re-action of the other body undergo the like change itſelf, though to the contrary part; and always loſes as much motion as it produces, imparts, or communicates.

Attraction is that force by which bodies are drawn, impelled, or in ſome manner made to move towards one another.

Thus gravity, which is proportionable to the quantity of matter in any body, comes under the denomination of attraction; of this we have daily inſtances in the falling of bodies to the Earth.

Now we are to underſtand that the huge bodies of the Planets muſt of conſequence be endowed with this property, and it ſeems natural to ſuppoſe that by this property they muſt tend ſomewhere.

But the omnipotent and omniſcient Contriver of the Univerſe, at the creation ſubjected all the properties of matter to certain laws, which are always inviolably kept: And there being the ſame propenſity in the planetary ſyſtem which is among other magnetic bodies, ſo that by their gravity they muſt have a mutual tendency one towards another, which is called the Centripetal Force, becauſe they gravitate one towards another, as towards a center or point.

But there is another force which is always equal and proportionable to this, which is called the Centrifugal Force, whereby they endeavour to recede or fly from each other; for it was intimated in Sir *Iſaac's* firſt law, that all motion is of itſelf rectilinear, which I ſhall demonſtrate in the following inſtance.

Suppoſe a man whirls a ſtone about in a ſling, ſo long as the ſtone remains therein it participates with the motion of the hand, which is circular; but ſlipping out of the ſling it is not now carried forward in its former circle, or in any circle at all, but in a tangent of a former circle, that is, in a right line from the periphery of the ſaid circle: But the force of gravity, compounded with the projectile force, is the reaſon why it deſcribes a parabolic line in falling to the ground, otherwiſe it would fly perpetually in a right line, as was obſerved before.

From the very nature of each of theſe two forces it is eaſy to conceive how the Planets are preſerved in their orbits; for as the centripetal force draws them towards each other, the centrifugal force prevents them; and as by their curvilineal motion they endeavour to fly from each other, the centripetal force obſtructs them; and thus they harmoniouſly chime by each other, diſplaying moſt beautifully the wonderful mechaniſm of the great Creator of the Univerſe, which may not unaptly be called the muſic of the ſpheres.

It muſt be obſerved that the orbits of all the Planets are not exactly circular but elliptical, having the Sun in their common focus. But the elliptic orbit of the Earth, by the action of the Moon, is ſenſibly diſfigured; as alſo the orbit of *Saturn*, by the action of *Jupiter*, when they are in conjunction. For it is evident by Sir *Iſaac's* third law, that the Moon and the Earth muſt have a mutual tendency towards each other; though the Earth, whoſe attraction is ſuperior to the Moon's, can compel the Moon to accompany her round the Sun, yet ſhe is ſo affected by the Moon's daily wheeling round her, as to be diverted from her own proper direction, and ſo occaſions the above irregularities in her orbit.

Let us contemplate on the omnipotence and omniſcience of the great Creator of the Univerſe. How beautiful and noble muſt the plan of our ſyſtem appear to us, when we conſider how the Earth and the reſt of the Planets perpetually wheel paſt each other, without danger of either obſtructing each other, or deviating from their orbits: So well it may be ſaid, He has hung the Earth upon nothing, and yet it is ſupported by ſuch attractive and repulſive pillars as will perpetually keep it from falling.

Perpetual motion, which has been in vain attempted by poor earthly mortals, is here preſented compleat to all beholders. But as he who formed this plan is in every reſpect infinite, ſo we are not capable of conceiving the greatneſs of his power, nor the profoundneſs of his wiſdom.

Why from yon arch, that infinite of ſpace,
With infinite of lucid orbs replete,
Which ſet the living Firmament on fire,
At the firſt glance, in ſuch an overwhelm
Of wonderful, on man's aſtoniſh'd ſight,
Ruſhes Omnipotence? —To curb our pride;
Our reaſon rouſe, and lead it to that pow'r,
Whoſe love lets down theſe ſilver chains of light,
To draw up man's ambition to himſelf,
And bind our chaſte affections to his throne.
Thus the three virtues, leaſt alive on Earth,
And welcom'd on Heav'n's coaſt with moſt applauſe,
An humble, pure, and heavenly-minded heart,
Are here inſpir'd:—And canſt thou gaze too long?
  Nor ſtands thy wrath depriv'd of its reproof,
Or unupbraided by this radiant choir.
The Planets of each ſyſtem repreſent
Kind neighbours; mutual amity prevails;
Sweet interchange of rays, receiv'd, return'd;
Enlight'ning, and enlighten'd! all, at once,
Attracting, and attracted! patriot-like,
None ſins againſt the welfare of the whole;
But their reciprocal, unſelfiſh aid,
Affords an emblem of millennial love.
Nothing in nature, much leſs conſcious being,
Was e'er created ſolely for itſelf:
Thus man his ſov'reign duty learns in this
Material picture of benevolence.

SECTION XXV.

Of the Invention of the ZODIAC.

THE Zodiac has been frequently mentioned in this work. It is therefore neceſſary more fully to explain the utility and origin of this very important circle.

The inhabitants of Chaldea are allowed the honour of the invention of the Zodiac, though ſome aſcribe it to the Egyptians; they both were people that delighted much in aſtronomy, and both were fathers of every race of men ſince the deluge. They remarked, that the Sun, with the whole heavens, daily turned and paſſed from eaſt to weſt; and, at the ſame time, they obſerved that the Sun, by a motion peculiar to itſelf, daily withdrew from certain ſtars, and placed himſelf under others in his progreſs to the eaſt; that the Moon twelve times finiſhed the ſame courſe to the Sun's once, and began the thirteenth before the Sun had entirely gone through it. The cuſtom of dividing the year pretty nearly into twelve moons, made men deſirous of having twelve parts of the year exactly equal among themſelves, or twelve months exactly equivalent to the year itſelf, by which they might be able to point out in the heavens, by ſhewing the particular ſtars, under which the Sun paſſed every month. They divided the Sun's path into twelve equal parts, or collections of ſtars, which they called conſtellations: thus our Chaldeans took two copper veſſels, both uncovered; one of them pierced at the bottom, the other not: having ſtopped the hole of the former, they filled it with water, and placed it ſo, that, at the turning of a cock, the water might diſcharge itſelf into the latter. After this they obſerved on that part of the heavens, which the Sun annually traces, the riſing of a ſtar, remarkable for either magnitude or brightneſs; and, the inſtant it appeared on the horizon, they began to diſcharge the water contained in the upper veſſel, letting it run the remainder of all that night, the day following, and to the very moment that the ſame ſtar, returning to the eaſt, appeared again. The inſtant it was diſcovered they removed the under veſſel, and threw away the water remaining in the upper.

The obſervers were certain, that they had the whole revolution of the heavens between the time of the firſt and ſecond riſing of the ſtar: wherefore the water, which had emptied itſelf into the under veſſel, during that ſpace, afforded them an exact method to meaſure the time of one revolution of the heavens, and to divide this ſpace into twelve equal parts; for, by dividing this water into twelve ſuch, they were certain to have the revolution of the 12th part of the heavens, in running off of this 12th part of the water; wherefore they divided the water of the under veſſel into twelve parts, exactly equal, and prepared two ſmaller veſſels, each capable of receiving and containing one of thoſe parts compleat, and no more. They then threw the whole quantity of water once more into the large veſſel, keeping the cock ſhut; after which they placed one of theſe ſmaller veſſels under the cock, and the other near it, to ſucceed to its place when the firſt was filled.

Having made theſe preparations the following night, they obſerved that part of the heavens, towards which they had long remarked that the Sun, Moon, and Planets directed their courſe, and waited the riſing of the conſtellation, ſince named *Aries*, or the Ram. The moment the Ram appeared, and that they ſaw his ſtar ariſe, they let the water run into the ſmaller veſſel, which, when it was full, they took away, and poured out, putting, that inſtant, another in its place. They obſerved with great exactneſs, and ſo as to remember, all the ſtars that aroſe during the time the veſſel was filling; and this part of heaven was terminated in their obſervation, by the ſtar which laſt appeared in the horizon, the moment the meaſure was exactly filled; ſo that, allowing time for theſe two ſmall veſſels to be alternately filled to the brims, each of them three times in the ſpace of the night, they, by this method, had one half of the Sun's rout, the exact half of the heaven itſelf; and this half, divided into ſix equal parts, of which they could ſhew and diſtinguiſh the beginning, middle, and end, by ſuch ſtars as are eaſy to be known again, either by their magnitude, number, or diſpoſition. As to the other half of the heavens, and the other ſix conſtellations, which the Sun paſſes through, they were obliged to refer their obſervations to another ſeaſon.

They waited till the Sun, being placed in the midſt of the conſtellations, already obſerved and known, afforded them the liberty to ſee thoſe others in the night. Being certain by this, or ſome other equivalent invention, of the great annual courſe which the Sun regularly keeps in the heavens, and of the equality of thoſe ſpaces which the conſtellations take up that bound his courſe, the obſervers thought of giving them names. They in general called them the ſtations or houſes of the Sun, and aſſigned three to each ſeaſon; they afterwards diſtinguiſhed every conſtellation by a particular name, by which they not only deſigned to make them reſpectively known to the people, but alſo, at the ſame time, to declare to them ſuch quality of the year as regardeth the whole ſociety, when the Sun reached ſuch a conſtellation.

It muſt be obſerved, that the names by which the twelve conſtellations in the Zodiac are diſtinguiſhed, were drawn from the moſt important events, occurring either in the heavens, or upon the earth, as the Sun poſſeſſes his ſtation under every one of them ſucceſſively.

By a viſible care of Providence, the dams of the flocks are commonly with young about the latter end of autumn. They are delivered of their burthens in winter, and in the ſpring. The young are kept from the ſeverity of the ſeaſon, by the warmth of their dams, during the cold; and quit them, without reluctance, at the return of warm weather.—Lambs are firſt brought forth; after theſe calves; and laſtly, kids: Thus the lambs get ſtrength ſufficient to follow the *ram* into the fields, when the fine weather begins; ſoon after, the calves and kids begin to ramble, and increaſing the flocks and herds, augment the revenue of their owner. Our Chaldean obſervers, knowing nothing produced during the ſpring, more uſeful than lambs, calves, and kids, impoſed the appellations of theſe three animals, which enrich the ſociety, on the conſtellations, under which the Sun paſſes during this ſeaſon.

The firſt they named Aries, or the Ram; the ſecond, Taurus, or the Bull; and the third, Gemini, or the two kids, to indicate the fecundity of goats, which oftener bring forth twins than one, and afford a quantity of milk more than ſufficient for their nouriſhment.

The whole race of men, being united in the plains of Irac, had often obſerved, that as the Sun drew towards them, he roſe to a certain height or point, which he did not go beyond; and that, as he retired from them, he deſcended, day by day, for the ſpace of ſix months, till he had reached another point much lower than the former, but did not paſs beneath it; This retreat of the Sun, which was performed very ſlowly, gave the obſervers occaſion to call the ſtars which follow the kids, or Gemini, by the name of Cancer, or the Crab, as that animal goes backward. When the Sun paſſes under the next conſtellation, it makes us ſenſible, even in our climes, of violent heats; but they are much more intenſe where mankind was then aſſembled. If the poets have attributed to this conſtellation all the rage and fury of Leo, or the Lion, which is the name it is known by, it is not difficult to perceive what determined the choice of that name from the earlieſt times.

Soon after the harveſt, both of hay and corn, is entirely finiſhed in the Eaſt, and nothing left upon the ground but a few ears, which they cauſe the moſt uſeleſs hands to gather: little girls are employed in this work. Could then a more proper name be adapted to the conſtellation, under which the Sun can diſcover no harveſt, than Virgo, or the young female-gleaner? Thoſe wings, which we ſee in the globes, are ornaments of a later date ſince the introduction of fables. The Virgin that follows the Lion is certainly no other than a gleaner or reaper, which you will ſee; and, leſt ſhe might be miſtaken for the other, ſhe carries in her hand a bundle of ears of corn, which is a natural proof of the origin I have given her.

The exact equality of the days and nights, which happen on the Sun's leaving Virgo, gave the next ſign the name of Libra, or the Balance. The frequent diſtempers the Sun either leaves or occaſions at this time, by his retreat, was the reaſon of giving to the following ſign the name of Scorpio, or the Scorpion, becauſe he is a noxious animal, and draws both his ſting and venom after him. Towards the end of autumn, the fall of the leaf expoſes the wild beaſts to view. The vintage is over, and all the fruits of the earth gathered in. The fields are all open, and it is of dangerous conſequence to ſuffer the increaſe of beaſts on the winter's approach. Every thing invites the ſportſman out, and the ſign in which the Sun then is has, therefore, taken the name of Sagittarius, the Archer, or Huntſman.

The nature of the wild Goat or Capricorn, which the firſt winter ſign is called, is to ſeek its ſuſtenance in ſearching from the foot to the ſummit of the higheſt mountains, climbing from rock to rock: Wherefore the name of this animal was very proper, to acquaint men with the very minute that the Sun was declined to its loweſt boundary; that he was going to aſcend again to the higheſt point of his career, and that he would continue thus aſcending for ſix ſucceſſive months. This is a direct contraſt to the Crab, and this lucky oppoſition of characters ſhews by what the firſt obſervers were directed in the impoſing the fore-mentioned names.

Aquarius and Piſces plainly denote a rainy ſeaſon; and that time of the year, when the fiſh, being more in their prime than any other, afford both profit and pleaſure of fiſhing. Of the twelve conſtellations, it may be obſerved, that often their names are borrowed of animals; whence it comes, that the annual circle, which they compoſe, has taken the name of Zodiac, or circle of animals: (for Zodiac comes either from *Zoe*, which in Greek ſignifies life; or from the Greek *Zodion*, a beaſt; but it rather ſeems to be derived from the former, becauſe all living creatures, which were painted therein, were not beaſts). By this ingenuity, men obtained a new method for the menſuration of time, and the regulation of all their labours. They before knew, without trouble or care, how to ſettle the order of their feaſts and common occurrences, by the phaſes of the Moon, without other aſſiſtance.

In acquiring the knowledge of the Zodiac, they alſo obtained a certain one of the year.

The conſtellations were, as well by their names as by their reſpective ſituations, real marks, by which they knew the order of their gathering in the different fruits of the earth, and by which they were taught what was neceſſary to be done towards the forwarding of their harveſt, as theſe ſigns ſhewed them at what diſtance of time it was to be expected. The people were neither under a neceſſity of reckoning the days, nor of ſetting down the order of time for their government.

Twelve words, adapted to twelve different parts of the heavens, was a ſcience as uſeful and advantageous to them, as it was eaſy to be acquired. When, after ſun-ſet, they ſaw the ſtars, which compoſe the Ram, appear above the oppoſite horizon, half the heavens diſtant from the Sun, they knew that bright luminary was then under the ſign of the Balance; which being the ſeventh of the celeſtial ſigns, was diſtant from the firſt of them the whole half of the Zodiac. When, towards the approach of day, they ſaw the brighteſt ſtar of the Lion in the middle of the heavens, equally diſtant from eaſt and weſt, they very readily conceived, that the Sun, which was near riſing, was at the diſtance of three ſigns from the Lion, and removed one quarter of his circle towards the eaſt. Thus, without ſeeing the Stars, which the Sun, paſſing under, hid by his brightneſs, they could tell you, with certainty, the Sun was now in the Bull; two months hence we ſhall have the longeſt days, &c. They could, by ſeeing one ſingle conſtellation, either in the Eaſt, the middle, or in the Weſt of the Heavens, inſtantly tell you where the Sun was, how far the year was advanced, and what buſineſs was proper to take in hand.

The firſt race of men, having no writing, read in the heavens what works they ſhould go upon, in the courſe of the year.

Even the uſeful invention of writing is the product of Aſtronomy; and it is nothing difficult to evince, that the giving names to the twelve Celeſtial Signs, produced the invention of painting and writing. This account diſcloſes to us an agreeable novelty, and will continue to diſcover how much we owe to the ſtudy of Nature.

The Earth, which produces all things, and is inceſſantly varying her production, was repreſented under the ſymbol of a fruitful woman, whoſe attributes were varied according to the feſtivals of works, which were deſigned to be proclaimed. This figure was named *Iſis*, that is, the woman, or queen. The creſcent, which was the token of the *Neomenia*, or aſſembly of people, being placed on her head, with ſuch or ſuch other attribute, might ſerve to denote the aſſembly of ſuch or ſuch a ſeaſon. The ſplendid *Dog-ſtar*, which begins to ſhew itſelf in the morning before the Aurora, and to diſengage itſelf from the Sun when that luminary is under the ſign of the *Lion*, was the never failing token of the time in which the *Nile* overflows its banks; it warned the * *Egyptians* to be ſpeedy in their retreat to the upper grounds, to make proviſion for their ſuſtenance, and to prevent ſurprize; doing them the ſervice of that animal, who gives his maſter notice of the approach of robbers; and it is for that very reaſon they repreſented it under the figure of a Dog, or under a human figure with a Dog's head, wings at the feet, and a kettle on its arm. The people eaſily underſtood this language, by which was figured to them the repoſe and inaction of their retreat, while the inundation continued, which would laſt all the time that the Sun continued under the Sign of the *Lion*; and *Virgo* was repreſented by a ſphinx, compoſed of a virgin's face, and the body of a Lion couchant, fixed on the borders of terraſſes in a conſtant inactive attitude. It very much concerned the *Egyptians* to be acquainted with the returns and duration of the *Eteſian* winds, which collected the vapours in *Æthiopia*, and by blowing from North to South about the latter end of the Spring, cauſed the inundation. It was afterwards of moment, to learn the return of the South wind, which contributed to the draining the waters off towards the *Mediterranean*. But how were theſe winds to be painted? To this end they made choice of a bird, which was the Hawk: * This bird turning towards the South, ſtretches his wings to renew his plumage upon the coming of great heats; and this was to repreſent the *Eteſian* winds which blew from North to South. And the ſymbol of the return of the South wind, proper for carrying off the waters, was the hoop, another bird which comes from *Æthiopia*, to ſeek for worms in the ſlime of the *Nile*, after the waters are run off. Theſe few examples may give an idea of the ſymbolical writing of the *Egyptians*, as it was peculiar to them, by the extenſive uſe they made of it; but the invention of the Zodiac, which gave ground to it, is more ancient than the Colony of *Egypt*, and comes from the plains of *Senaar*: For had the *Egyptians* been the firſt authors of the celeſtial ſigns and names, they would never have placed the figure of a female gleaner after the ſign of the Lion, to denote the Harveſt; for though, at this time, it is over in other places, it is not near in *Egypt*, the country being then all under water. In *Egypt* they do not put their ſeed into the ground till *November* is pretty far advanced, and they reap in *March* or *April*, ſo that their corn takes no more than four months to ripen.

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* Thoſe deſirous of being informed of the curious phænomena of the Heavenly Bodies as they appear in different countries, are referred to a treatiſe lately publiſhed, being A New Introduction to the Knowledge and Use of Maps, rendered eaſy to any capacity; in which younger minds will find much entertainment and improvement.

This ſymbolical writing, the firſt product of Aſtronomy, was made uſe of to inſtruct the people in all manner of truths, in all opinions, and in all neceſſary works; but it became troubleſome by the multiplicity of figures and attributes, which increaſed in proportion to the number of objects; as inconvenience found in the *Chineſe* writing, for they have a diſtinct mark for every particular figure. A great genius, whoſe name hiſtory does not mention, but who lived before *Moſes*, and is very different from *Cadmus*, to whom the *Greeks* give the honour of this invention, obſerving that the ſounds and articulations of the voice, with which we expreſs all things, are but few in number, thought of repreſenting theſe ſounds and articulations by the ſame number of characters, which do not exceed twenty-four.

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* *Job* xxxix, ver. 26,

This writing, which by repreſenting the ſound of the voice, has power to expreſs all the thoughts and objects, which are uſed to be denoted by thoſe ſounds, appeared ſo plain and fertile, that it was immediately embraced, and extended itſelf into all parts. It became the cuſtomary way of writing, and cauſed ſo great a neglect of the ſymbolical, that, by degrees, the uſe of it was loſt, and its ſignification entirely forgot.

How much therefore are we indebted to Aſtronomy! it has taught us to meaſure our months, years, and to divide our ſeaſons, and clearly demonſtrates the benevolence, as well as power, of the Deity, in commiſſioning the bright Hoſt of Heaven to ſhine for the utility and inſtruction of mankind, as the ſublime author of *Night Thoughts* thus finely deſcribes.

Stars teach, as well as ſhine. At Nature's birth,
Thus their commiſſion ran—" Be kind to man."
Where art thou, poor benighted traveller!
The Stars will light thee; though the Moon ſhould fail.
Where art thou, more benighted! more aſtray!
In ways immoral? the Stars call thee back;
And, if obey'd their counſel, ſet thee right.
Where art thou, *Virtue-militant!* the Stars
Are thine allies, all liſted on thy ſide:
By thouſands, and ten thouſands, they advance
Their bright battalions, in fair Virtue's cauſe;
And keep ſtrict watch, and nightly light their fires,
Fires of alarm, to warn thee of the foe;
The foe that claims theſe regions as his own;
Uſurper bold! high-ſtyl'd, *The prince of air!*
Beneath night's awful banner, let us draw

Siderial *Wiſdom*'s formidable ſword,
And ſend him headlong to far other flames.
MICHAEL's alone, the ſword his mighty arm
Pluck'd from the golden column in the mount,
The mount celeſtial, where the ſons of GOD
Hang up Heav'n's vengeance far above the Stars,
Above the * *Sagittary*'s humble bow ;
Could give the ſwarthy *Dæmon* deeper wound.

And was there need of ampler field than this,
What giant-angels giant-angels met,
In fiery conflict, and outrageous ſtorm,
To controvert the ſceptre of the Skies ?

This proſpect vaſt, what is it ?—Weigh'd aright,
'Tis Nature's ſyſtem of divinity,
And ev'ry ſtudent of the night inſpires.
'Tis elder ſcripture, writ by GOD's own hand ;
Scripture authentic ! uncorrupt by man.
LORENZO ! with my radius (the rich gift
Of thought nocturnal !) I'll point out to thee
Its various leſſons ; ſome that may ſurpriſe
An unadept in myſteries of Night ;
Little, perhaps, expected in her ſchool,
Nor thought to grow on Planet, or on Star.
Bulls, *Lions*, *Scorpions*, *Monſters* † here we feign ;
Ourſelves more monſtrous, not to ſee what here
Exiſts indeed ;—a lecture to mankind.
What read we here ?—Th' exiſtence of a GOD ?—

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* *i. e.* the ſign *Sagittarus* ♐ the Archer.
† Signs of the Zodiac.

SECTION XXVI.

An eaſy Method of diſcovering all the Stars in the ZODIAC, *and to know them by their reſpective Names.*

THE Moon, by its ſwift motion, paſſes through all the Signs of the Zodiac in the ſpace of one month; therefore by turning to the Ephemeris we are informed under what Conſtellation or collection of Stars the Moon then is, and thus by obſerving where the Moon is, it will ſerve as a direction to the Stars.

For EXAMPLE.—I hear the Seven Stars often mentioned, and frequently meet with paſſages in Holy Writ, &c. that take notice of the *Pleiades*, and are deſirous of finding thoſe Stars in the Heavens. To accompliſh this, inſpect the Ephemeris, that part which we have inſerted for *March* 1774, will anſwer for the preſent purpoſe. For inſtance, The Seven Stars or *Pleiades* are in the neck of the *Bull* or *Taurus*, therefore examine when the Moon is in this Sign.

By running your eye down the third column of the Ephemeris (being the Moon's motion) ♉ *Taurus* will be ſeen, and in the firſt column you will ſee 15, which implies that on the 15th day of the month the Moon enters into the *Taurus*; but the *Pleiades* being 25 degrees in ♉ *Taurus*, and the Moon's motion being about 12 or 13 degrees in a day, the Moon therefore cannot arrive at the *Pleiades*, or Seven Stars, till the 17th day of that month, and then will (if fine) be ſeen to paſs almoſt under the *Pleiades*. It will be curious to obſerve the Moon's ſwift approach to thoſe Stars, as on the 15th the Moon will be ſeen at a conſiderable diſtance from them; on the 16th will approach nearer, and on the 17th day of *March*, will have juſt paſſed them; and on the 18th, the Moon will be ſeen very near a large conſpicuous Star of the firſt magnitude, called *Aldebaran*, or the *Bull*'s *Eye*; but on the 19th the Moon will have left this Star, and get conſiderably to the eaſtward of it, as being then in the Sign *Gemini* ♊. On the 20th the Moon will enter into the Sign ♋ *Cancer*; on the 23d will be in the Sign ♌ *Leo*, and on the 24th will be very near a beautiful large Star of the firſt magnitude, called *Cor Leo*, or the *Lion's Heart*; the Moon will be ſeen to paſs cloſe under this Star. On the 26th of *March* the Moon will have advanced into the Sign ♍ *Virgo*, and if the evening ſhould prove clear, the Moon will be ſeen cloſe to that very large * Star in *Virgo*, called *Spica*; on the 28th the Moon will enter the Sign ♎ *Libra*, and on the 31ſt ſhe will be in ♏ *Scorpio*.

Theſe inſtructions will be ſufficient, as it is only referring to the Ephemeris, which will at any time deſcribe what Sign the Moon is in, and it is only taking notice of the form of thoſe Stars in the Heavens, and thus by tracing the Moon from time to time, on a clear night you will be enabled, by a little attention, to know the name and poſition of all the Stars or Signs in the Zodiac. Theſe obſervations will make your walks in the winter evenings very agreeable, and I will venture to affirm, that thoſe who make theſe Sciences their ſtudy will be amply rewarded with the moſt rational delight; they will find their conceptions magnified, their ſentiments bold and full of dignity. They will ſoar above this Earth, which is like a marble amidſt the infinitude of *revolving worlds*, and meaſure the azure robe of infinite ſpace ſtudded with myriads of refulgent orbs, which is thus beautifully deſcribed by that ſublime Poet, Dr. *Young*.

Let thought awaken'd take the lightning's wing
And glance from EAST to WEST, from POLE to POLE,
Who ſees, but is confounded, or convinc'd?
Renounces reaſon, or a GOD adores?
LORENZO! much of moral haſt thou ſeen,
Of curious arts art thou more fond? Then mark
The mathematic glories of the Skies
In number, weight, and meaſure, all ordain'd.

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* I have endeavoured to point out the moſt conſpicuous Stars; as on moon-light evenings the Stars, eſpecially thoſe near the Moon, appear but ſmall, as the ſplendour of their light is much diminiſhed by the more powerful light of the Moon; but when once known, may be found again when the Moon has left them, and then they will appear in their full magnitude and brightneſs.

Lorenzo's boaſted builders, *Chance* and *Fate*,
Are left to finiſh his ærial towers;
Wiſdom and Choice, their well-known characters
Here deep impreſs, and claim it for their own.
Though ſplendid all, no ſplendour void of uſe:
Uſe rivals Beauty: Art contends with Pow'r;
No wanton waſte, amid effuſe expence;
The great Œconomiſt adjuſting all
To prudent pomp, magnificently wiſe.
How rich the proſpect! and for ever new!
And neweſt to the man that views it moſt;
For newer ſtill in infinite ſucceeds.
Then, theſe ærial racers, O how ſwift!
How the ſhaft loiters from the ſtrongeſt ſtring!
Spirit alone can diſtance the career.
Orb above orb aſcending without end!
Circle in circle, without end, incloſ'd!
Wheel within wheel; Ezekiel! like to thine!
Like thine, it ſeems a viſion, or a dream;
Though ſeen, we labour to believe it true!
What involution! what extent! what ſwarms
Of worlds, that laugh at Earth! immenſely great!
Immenſely diſtant from each other's ſpheres!
What, then, the wondrous ſpace thro' which they roll?
At once it quite ingulfs all human thought;
'Tis comprehenſion's abſolute defeat.
Nor think thou ſeeſt a wild diſorder here;
Through this illuſtrious chaos to the ſight,
Arrangement neat, and chaſteſt order reign.
The path preſcrib'd, inviolably kept,
Upbraids the lawleſs ſallies of mankind.
Worlds ever thwarting, never interfere;
What knots are ty'd! how ſoon are they diſſolv'd,
And ſet the ſeeming marry'd Planets free!
They rove for ever, without error rove!
Confuſion unconfus'd! Nor leſs admire
This tumult untumultuous; all on wing!
In motion, all! yet what profound repoſe!

What fervid action, yet no noiſe! as aw'd
To ſilence, by the preſence of their LORD:
Or huſh'd, by his command, in love to man,
And bid let fall ſoft beams on human reſt,
Reſtleſs themſelves. On yon cœrulean plain,
In exultation to their GOD, and thine,
They dance, they ſing eternal Jubilee,
Eternal celebration of his praiſe.
But ſince their ſong arrives not at our ear,
Their dance perplex'd exhibits to the ſight
Fair hieroglyphic of his peerleſs power.
Mark, how the labyrinthian turns they take,
The circles intricate, and myſtic maze,
Weave the grand cipher of Omnipotence;
To gods, how great! how legible to man!

SECTION XXVII.

Of the VIA LACTEA, *or* MILKY WAY.

THE *Via Lactea*, by the *Greeks* called *Galaxy*, or the *Milky Way*, is a broad white lucid tract in the Heavens, and extending itſelf in ſome places with a double path; but for the moſt part with a ſingle one. The antients imagined that this path conſiſted only of a certain exhalation hanging in the air; but by the teleſcopical obſervations of the preſent age, it hath been diſcovered to conſiſt of an innumerable quantity of fixed Stars, as large as thoſe we generally ſee, but their great diſtance renders them ſo ſmall as to be inviſible to the naked ſight, which can only diſcern a whitiſh tract produced by their ſplendor, called the *Milky Way*. The *Pythagoreans* thought the Sun had once gone in this tract inſtead of the ecliptic, and conſequently that its whiteneſs proceeds from the remains of his light. As the *Via Lactea* is compoſed of an infinity of ſmall Stars, ſo it has uſually been the region in which new Stars have appeared. As the new Star in *Caſſiopea*, which was firſt ſeen, A. D. 1572; it ſurpaſſed *Sirius* (*i. e.* the Great Dog Star) in brightneſs and magnitude, and was ſeen for ſixteen months ſucceſſively; at firſt it appeared bigger than *Jupiter*, and was ſeen at mid-day; afterwards it decayed gradually both in magnitude and luſtre, until *March* 1573, when it became inviſible; that in the breaſt of the Swan, and another in the knee of *Serpentarius*, and ſeveral others in this tract which have appeared for a while and then diſappeared again. The Milky Way runs through *Caſſiopea*, *Perſeus*, and *Auriga*, by the feet of *Gemini*, and the club of *Orion*, and in the Southern it purſues its courſe through *Scorpio*, *Sagittarius*, &c.

This is part of the courſe of that ſingular and beautiful appearance through the Heavens; many of the commentators on the book of *Job* have ſuppoſed that this Milky Way is the part of the Heavens referred to in that paſſage, where the Author, ſpeaking of the Almighty, ſays, that *his ſpirit beautified the Skies, and his hands formed the crooked ſerpent.* There are alſo two white ſpots towards the South Pole like little clouds, and of the ſame colour with the *Galaxy* or Milky Way, which the Mariners call the Clouds of Magellan, becauſe they are over thoſe parts of the Earth which were diſcovered by him. Theſe appear through Teleſcopes to be a mixture of ſmall clouds and ſtars; but the moſt remarkable of all the cloudy ſtars is, that in the middle of *Orion's Sword* where ſeven Stars (of which three are very cloſe together) ſeem to ſhine through a cloud very lucid, near the middle, but faint and ill defined about the edges; it looks like a gap in the Sky, through which one may ſee (as it were) part of a much brighter region, which *Milton* thus finely deſcribes.

> The Heavens and all the conſtellations rung;
> The Planets in their ſtations liſtning ſtood,
> While the bright pomp aſcended Jubilant
> Open, ye everlaſting gates, they ſung,
> Open, ye Heavens, your living doors, let in
> The GREAT CREATOR, from his work returned
> Magnificent, his ſix days work, a world;
> Open, and henceforth oft; for God will deign
> To viſit oft the dwellings of juſt men

Delighted, and with frequent intercourſe
Thither will ſend his winged meſſengers
On errands of ſupernal grace, ſo ſung
The glorious train aſcending: He through Heaven
That open'd wide her blazing portals, led
To God's eternal houſe direct the way,
A broad and ample road, whoſe duſt is gold
And pavement Stars, as Stars to thee appear
Seen in the GALAXY that MILKY WAY,
Which nightly as a circling Zone thou ſeeſt
Powder'd with Stars.

Although moſt of theſe ſpaces are but few minutes of a degree in breadth, yet ſince they are among the fixed Stars, they muſt be ſpecies larger than what is occaſioned by our Solar Syſtem, and in which there ſeems to be a perpetual uninterrupted day among numberleſs worlds, which no human art ever can diſcover. Thus have we a kind of *New Creation*, as Dr. *Young* elegantly expreſſes it—

Say, gentle night! whoſe modeſt maiden beams,
Give us *a new Creation*, and preſent
The worlds great picture, ſoftened to the ſight;
Nay, kinder far, far more indulgent ſtill
Say thou, whoſe mild dominions ſilver key
Unlocks our Hemiſphere, and ſets to view
Worlds beyond number; worlds concealed by day
Behind the powerful Star of noon?
Canſt thou not draw a deeper ſcene, and ſhew
The mighty POTENTATE to whom belong
Theſe rich *regalia* pompouſly diſplay'd,
To kindle that high hope? like him of *Uz*
I gaze around, I ſearch on every ſide,
A Star his dwelling pointed out below,
Ye *Pleiades! Arcturus! Mazaroth!*
And thou *Orion!* of ſtill keener eye?
Say ye who guide the wilder'd in the waves,
And bring them out of tempeſt into port!

On which hand muſt I bend my courſe,
To find the Great Immanuel ?
——Divine Instructor ! thy firſt volume *this*
For *Man's* peruſal : all in Capitals !
In *Moon* and *Stars* (Heaven's golden Alphabet)
Emblaz'd to ſeize the ſight—who runs may read,
Who reads can underſtand. 'Tis unconfin'd
To *Chriſtian* land or *Jewry* ; fairly writ
In language univerſal, to MANKIND !
A language lofty to the learn'd : yet plain
To thoſe that feed the flock, or guide the plough,
Or from the huſk ſtrike out the bounding grain.
A language worthy the Great Mind, that ſpeaks
Preface and comment to the ſacred page !
Which oft refers its readers to the ſkies,
As preſuppoſing his firſt leſſon there.

SECTION XXVIII.

The Survey of the Heavens teaches us not to over-value the World.

THE infinite art of the Creator is viſible through all nature.—By art I mean, an aſſemblage of means expreſsly choſen to arrive at an appointed end. And nothing is more conſpicuous to man than the celeſtial Orbs. And, from the conſideration of the prodigious magnitude and multitude of the heavenly bodies, and the far more noble furniture and retinue which ſome of them have more than our Earth, we may learn not to over-value this world, nor to ſet our hearts too much upon it, or upon any of its riches, honours, or pleaſures. For what is all our Globe, but a point, a trifle to the Univerſe ? a ball not ſo much as viſible amongſt the greateſt part of the heavens, namely, the fixed Stars. And, if magnitude or retinue may dignify a Planet[*], *Saturn* and *Jupiter* may claim the preference; or, if proximity to the moſt magnificent Globe of all the ſyſtem, that great fountain and ſource of light and heat, can aggrandize a planet, then *Mercury* and *Venus* can claim that dignity. If, therefore, our World be one of the inferior parts of our ſyſtem, why ſhould we inordinately ſeek and deſire it? But above all, why ſhould we unjuſtly graſp at it, and be guilty of theft or rapine, lying or cheating, or any injuſtice for it? Why ſhould we ſacrifice our innocence, or part even only with a good name for it, which *Solomon* ſaith, *is rather to be choſen than great riches.* Why ſhould we do thus, if we were ſure of gaining the whole terraqueous Globe, much leſs for ſo ſmall a pittance of it? What is a man profited, if he ſhould gain the whole world, and *loſe himſelf?*

But, paſſing over the arguments which Chriſtianity ſuggeſts, let us ſee how ſome even of the heathen writers deſcant upon this ſubject. *Pliny*, in his Natural Hiſtory, exclaims, *Hæ tot portiones terræ*, &c. *i. e.* Theſe little parcels of land, which are left for our habitation; yea, as many have taught, this point of the world (for no other is the Earth in reſpect of the Univerſe) this is the matter, this the ſeat of our glory: here it is we bear our honours; here we exerciſe our authority; here we covet riches; here mankind make a buſtle; here we begin our wars, and ſoften the earth with mutual ſlaughters." And then, having ſhewn how by fraud and violence men ſtrive to enlarge their eſtates, ſaith he, "What a little part of thoſe lands doth he enjoy! and when he hath augmented them even to the meaſure of his avarice, what a poor pittance is it that his dead body at laſt poſſeſſeth?"—Thus *Pliny*, and after the ſame manner *Seneca* reflects upon the matter, when he ſhews how Virtue tends to make a man compleatly happy; among other things, by preparing him for the ſociety of GOD, by enabling the mind to ſoar above the things here below.—"O!" ſays this great philoſopher, "how ridiculous are the bounds of mortals! The *Iſter* bounds the *Dacians*; the *Strymon* the *Thracians*; the *Euphrates* the *Parthians*; the *Danube* parteth the *Sarmathians* and *Romans*; the *Rhine* gives bounds to *Germany*; the *Pyrenees* to *France* and *Spain*; and between *Egypt* and *Ethiopia* lie the vaſt uncultivated deſarts. If any could give human underſtanding to ants, would not they too divide their mole-hills into divers provinces? and when thou lifteſt up thyſelf, and ſhalt ſee the armed hoſt paſſing here and lying there, as if ſome great matter was to be acted, conſider that this is no more than the running of ants in a mole-hill: for what difference between them and us, but only the meaſure of a little body? That is but a point in which thou ſaileſt, in which thou wageſt war, in which thou diſpoſeſt of kingdoms. But above there are vaſt ſpaces to whoſe poſſeſſion the mind is admitted, provided it brings but little of the body with it; that it is purged of every vile thing, and that it is refined, free, and content." And ſo he goes on to ſhew, that when the mind is once arrived to thoſe celeſtial regions, how it comes to its proper habitation; is delivered from its bonds; hath this argument of its divinity, that ſublime things delight and pleaſe it, and is converſant with them as its own; that it can ſecurely behold the riſing and ſetting, and the various courſes of the ſtars; that it curiouſly inſpects into all thoſe matters, as nearly appertaining to itſelf; that then it contemns the narrow bounds of its former habitation; it being but a trifling ſpace, or a few days journey from the utmoſt limits of *Spain* to the very *Indies*; whereas the celeſtial regions afford a path for the wandering of the ſwifteſt ſtar for thirty years, without any reſiſtance; in which regions, he tells us, the mind arrives to the knowledge of thoſe things at laſt, which it had long before enquired after, and there begins to know GOD. Thus the antient *Seneca*, whoſe mode of reaſoning is not unworthy the attention of the preſent enlightened age, to whom the cultivation of this ſcience is recommended; as from hence we attain the higheſt and moſt ſublime ideas the human mind is capable of forming of the Great Author and Sovereign of all things. Mr. *Thompſon* ſeems replete with ſuch ideas, when he thus harmonious ſings:

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[*] ☞ *Thus far we have only treated of the Planets, of their reſpective orbits, motions, and aſpects. But, for a more accurate inveſtigation of theſe and other ſubjects, we take the liberty to refer our Readers to a work, now in the Preſs, which will ſpeedily be publiſhed. It is deſigned as a Supplement to this Volume, and will contain accurate deſcriptions of the Planets, and clear demonſtrations, that they are, what has been frequently conjectured,* CELESTIAL WORLDS, *ſubject to Phyſical laws nearly correſponding with thoſe of our Earth. The length of their days, nights, months, and years; their ſeaſons, moons, eclipſes, and different degrees of heat and cold, the reſult of their different atmoſpheres, will in that work be clearly demonſtrated, and accurately aſcertained, by the help of ſome late diſcoveries made by modern and much improved glaſſes. In this work will be thrown out rational conjectures relative to the interior parts of thoſe* PLANETARY WORLDS, *illuſtrated with Copper-Plates, exhibiting a ſtriking reſemblance of thoſe Celeſtial Orbs, as they appear when viewed through modern reflecting teleſcopes. The whole concluding with cogent arguments, deduced from Reaſon, Nature, and Religion, tending to evince the probability of their being inhabited; with the compleat Phænomena of the Heavenly Bodies.*

With thee, ſerene PHILOSOPHY, with thee,
And thy bright garland, let me crown my ſong!
Effuſive ſource of evidence, and truth!
A luſtre ſhedding o'er th' ennobled mind,
Stronger than ſummer-noon; and pure as that,
Whoſe mild vibrations ſooth the parted ſoul,
New to the dawning of celeſtial day.
Hence thro' her nouriſh'd powers, enlarg'd by thee,
She ſprings aloft, with elevated pride,
Above the tangling maſs of low deſires,
That bind the fluttering crowd; and, angel-wing'd,
The heights of ſcience and of virtue gains,
Where all is calm and clear; with Nature round,
Or in the ſtarry regions, or th' abyſs,
To Reaſon's and to Fancy's eye diſplay'd:
The *Firſt* up-tracing, from the dreary void,
The chain of cauſes and effects to HIM,
The world-producing ESSENCE, who alone
Poſſeſſes being; while the *Laſt* receives
The whole magnificence of heaven and earth,
And every beauty, delicate or bold,
Obvious or more remote, with livelier ſenſe,
Diffuſive painted on the rapid mind.

Tutor'd by thee, hence POETRY exalts
Her voice to ages; and informs the page

With muſic, image, ſentiment, and thought,
Never to die! the treaſure of mankind!
Their higheſt honour, and their trueſt joy!
Without thee, what were unenlighten'd Man!
A ſavage roaming thro' the woods and wilds,
In queſt of prey; and with th' unfaſhion'd furr
Rough clad; devoid of every finer art,
And elegance of life. Nor happineſs
Domeſtic, mix'd of tenderneſs and care,
Nor moral excellence, nor ſocial bliſs,
Nor guardian law were his; nor various ſkill
To turn the furrow, or to guide the tool
Mechanic; nor the heaven-conducted prow
Of navigation bold, that fearleſs braves
The burning line, or dares the wintry pole;
Mother ſevere of infinite delights!
Nothing, ſave rapine, indolence, and guile,
And woes on woes, a ſtill-revolving train!
Whoſe horrid circle had made human life
Than non-exiſtence worſe: but, taught by thee,
Ours are the plans of policy, and peace;
To live like brothers, and conjunctive all
Embelliſh life. While thus laborious crowds
Ply the tough oar, PHILOSOPHY directs
The ruling helm; or like the liberal breath
Of potent Heaven, inviſible, the ſail
Swells out, and bears th' inferior world along.
Nor to this evaneſcent ſpeck of earth
Poorly confin'd, the radiant tracts on high
Are her exalted range; intent to gaze
Creation thro'; and, from that full complex
Of never-ending wonders, to conceive
Of the SOLE BEING right, who *ſpoke the word*,
And Nature mov'd compleat.

SECTION XXIX.

General Reflections on the Wonders of Creation.

WHEN we ſurvey the various works of Nature and ſeriouſly meditate on them, when we view the wonders of the Heavens or airy ſpace, the beauties which adorn the Earth, the numberleſs variety of creatures which range its ſurface, wing the ætherial regions or glide within the womb of the vaſt deep; when we conſider every ſpecies ſo curiouſly and wonderfully formed, we cannot well avoid perceiving the whole creation to be big with art.

> And open to raviſh'd thought that intellectual ſphere,
> Where *Order*, *Wiſdom*, *Goodneſs*, *Providence*,
> Their endleſs miracles of love diſplay,
> And promiſe all the truly great deſire.

When we ſee every thing to ſupply our wants, allay our cares, pleaſe our ſenſes, and employ our minds, what ſtrong motives, what cogent reaſons have we to wonder at the Great Creator's power, admire his wiſdom and revere his goodneſs; all which are ſo viſibly diſplayed, and ſo ſtrongly ſtamped on every individual of his creatures, who has endued us (above all the living kinds below) with the powers of reaſon and reflection, whereby we are inabled to chuſe our preſent and future good, to trace the footſteps of his wiſdom, to admire his wonderful works. It is alſo obſerved by the royal Pſalmiſt, that the works of the great Author of Nature every where preach and proclaim the high original from whence they ſprung; that *their ſound is gone out into all lands, and their words unto the end of the world*; *that there is neither ſpeech nor language where their voices are not heard amongſt them.*

Every perſon therefore who neglects the contemplation of Nature, deprives himſelf of one of the moſt exalted pleaſures of life, and robs the Deity of that honour and praiſe which ſuch contemplation muſt neceſſarily raiſe in the mind of every one employed therein; let us therefore ſtudy this great volume of the world, for it is one of the * Supreme's books, wherein we may read, in the moſt legible characters, the being, and providence of its divine Author, who is infinite in all perfection.

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* ——— For Heaven
Is as the Book of God before thee ſet,
Wherein we read his wond'rous works. MILTON.

In a word, at thoſe times when the mind is relaxed or ſick of the world and itſelf, it will find an agreeable Aſylum here; ſomething ever new will pleaſingly preſent itſelf, and our ideas will be much enlarged and brightened, when we recollect, that if we have lived good and virtuous lives upon this our probationary Planet below, we ſhall want but a ſtep or two to penetrate into the immortal abodes of the bleſſed and be happy for ever. As a modern Poet, in his *Epiſtles to Lorenzo*, finely argues:

For why was ſpeculation given
If not to teach the way to Heav'n?
What need have animals below
The Planet's paths above to know?
Or in what curves, meand'ring, rove
Satellites round the orb of *Jove*?
Lends art its microſcopick eye,
In Nature's miniature to pry?
To ſee beneath the civil knife
The butcher'd atoms robb'd of life;
To know that 'ſcaping from the ſteel,
Thouſands may periſh at a meal:
While, conſcious ev'ry ſtep we tread,
We trample hoſts of beings dead.
Ah, why this knowledge giv'n, to raiſe
Our wonder to our Maker's praiſe;
Why hence inſpir'd our God t'adore,
If ſeen, in death, his face no more?
It cannot be.—Of Heav'nly birth,
Science, no offspring of the Earth,
To man hath *Jacob's* ladder giv'n,
Reaching, its foot on Earth, to Heav'n.
O, ſeize, with ardour ſeize the prize;
And claim thy kindred to the Skies.
Genius, *Lorenzo*, yours or mine,
Faint image of the pow'r divine;

Endow'd with ev'n creative pow'r,
To form the beings of an hour,
To people worlds, to light the Skies,
To bid a new creation riſe.
Ev'n here my friend, in Nature's plan
Trac'd the divinity of Man.
A truth that genius feels and knows,
As oft as with the God it glows.
And ſhall t'oblivion be conſign'd
This portion of etherial mind ?
O, no.—Come death in any form,
I doubt not to ride out the ſtorm ;
The ſhipwreck'd body to ſurvive ;
My thinking part ſtill left alive.
Mean while, through all the modes of ſenſe,
Bear me, bold Contemplation, hence.
On thy firm wing, O, let me ſoar ;
And idly hope and fear no more.
Bear me to th' ever-blooming groves,
Where genius with fair ſcience roves ;
Where, in the cool ſequeſter'd ſhade,
Sits Reſignation, pious maid ;
To Heav'n directed by whoſe eye,
When drooping Nature calls to die,
Let this my lateſt wiſhes crown,
On her ſoft lap to lay me down ;
Whilſt mild content, and gentle peace,
Her handmaids, waiting my releaſe,
Strow, ſtealing round with ſofteſt tread,
Their grateful roſes o'er my bed,
No thorn among, to break my reſt ;
By euthanaſian ſlumbers bleſt ;
Without a ſigh, at cloſe of day,
To breathe, becalm'd, my ſoul away.

F I N I S.